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Orion Exclusive — Special Edition!

Celestron f/10 & f/6.3 Ultima 8 PEC Package

High-Tech White Finish!

By special arrangement with Celestron International, Orion is offering the advanced Ultima 8 telescope with a new high-tech white finish and an expanded accessory package at a special price that is sure to appeal to the advanced amateur astronomer.

The Special Edition Celestron Ultima 8 PEC has all the features of the popular standard model, including the renowned Celestron 8" optical system with Starbright coatings and Byers drive system with electronic control system and Periodic Error Correction.

Special bonus accessories include:

- Celestron f/6.3 photo-visual Reducer/ Corrector for wide-field performance ideal for astrophotography
- 35mm camera T-adapter
- Tele-extender for high power planetary photography
- 12.5mm (160x) Ultima eyepiece
- Electric declination motor drive
- Electric focus motor.

Of course, you get all the standard Ultima accessories, too:
- Improved adjustable field tripod
- Heavy duty equatorial wedge
- 30mm Plössl eyepiece (68x)
- 7mm Orthoscopic ocular (290x)
- Multi-coated 1.25" prism star diagonal
- Convertable 8x50 finder scope
- Push-button hand controller
- Setting circles
- Premium storage case

Plus, Orion is including a FREE Ultrascopic 3-element barlow lens, a $64.95 value!

This feature packed package is an incredible value! **Available for a limited time at a special package price *only* from Orion Telescope Center.**

Complete Package
#21090 **$2399** (55.92)

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Orion® 7x50 & 10x50 Observer™ Binoculars

Fine quality, moderately priced binoculars, excellent for both astronomy and daytime observation. Fully coated optics, rugged ribbed rubber covering for a good grip. Both have a 7° field of view.

7x50 #9620
***NEW!** 10x50* #9623
$84.95 (4.44)

Orion® 7x50 & 10x50 Explorer™ Binoculars

Our newest high performance binoculars with BAK-4 prisms and Multi-Coatings. Great for both astronomy and daytime observation. Comfortable ergonomic body design.

7x50 #9306 **$109** (4.71)
10x50 #9308 **$114** (4.71)

Orion® 8x56 Mini Giants

56mm objective lenses gather over 2.5x the light of ordinary 7x35 binoculars. Perfect for viewing faint celestial objects, daytime viewing. Best Multi-Coated BAK-4 optics. 6° field of view. Standard model 33 oz. Rubber Armored for protection from bumps. Weighs 37 oz.

***NEW!** Rubber Armored Model* #9627 **$149** (5.07)
Standard Model #9504 **$149** (4.71)

Superior Performance 7x50 Adlerblick Binoculars

Incredible wide field eyepiece design. Fully Multi-Coated, BAK-4 prisms, and best special glass objective lenses make the 7x50 Adlerblick the arch rival of European brand binoculars selling for 3-4 times the price. Orion buys direct, saving you money. Includes deluxe hard case, lens caps and straps.

#9612 **$279** (5.28)

Orion® 10x70 Fully Multi-Coated Enhanced Giants

The standard for hand-holdable astronomy binoculars. 33% lighter—weighs only 58 oz.—yet the same brightness and 7mm exit pupil as our 11x80 MC model. Superior "BCF" body design. Includes: soft rubber eyecaps, tripod mounting adapter, durable hard carrying case, lens caps and straps.

#9501 **$299** (6.97)

Orion® 80mm Enhanced Giant Binoculars

20% more light transmission than ordinary "fully coated" binoculars. Fully Multi-Coated optics and superior BAK-4 prisms provide fantastic contrast and greatly improved edge sharpness.

11x80 MC Brightest, widest field available. Ideal for deep-space observation under dark skies. Hand-holdable.
#9502 **$369** (8.05)

16x80 MC 45° higher power, excellent for astronomy and daytime observation. Tripod recommended.
#9496 **$379** (8.05)

20x80 MC Highest power model perfect for smaller deep-space objects and long range daytime views. Tripod required.
#9498 **$389** (8.05)

SuperGiant™ 14x100

Gigantic, almost 4 inch, lenses gather 156% of the light of 80mm binoculars. Individual eyepiece focus; fully multi-coated optics and BAK-4 prisms. Comes with tripod mounting plate and metal-clad case. 14x magnification; field of view 3.3°, exit pupil 7.0mm, weight 7.5 lbs., height 13.5".

#9495
$849 (17.12)

Orion® 12.5mm Plössl Illuminated Reticle Eyepiece

This new 12.5mm 4-element Plössl offers unprecedented eye relief and observing comfort during long astrophoto exposures. The battery operated integral illuminator has fully adjustable brightness. Features double crossline reticle.

#8484 **$129** (3.45)

World's Finest Illuminated Reticle Eyepiece

6mm Orthoscopic design for required high power guiding, plus unique X-Y adjustable reticle positioning for easy guide star alignment. Wireless LED illuminator has adjustable brightness.

#8487 **$149** (3.67)

Orion® 9mm Orthoscopic Illuminated Reticle Eyepiece

9mm Orthoscopic eyepiece with wireless adjustable brightness illuminator. Bull's-eye within three concentric circles helps measure limits of acceptable guiding error.

#8488 **$119** (3.67)

Orion® 12mm Kellner Illuminated Reticle Eyepiece

12mm Kellner eyepiece with cable plugs into LX/3, LX/5 and Premier drive bases, and most drive correctors with illuminated reticle output for polar alignment and guiding.

#8482 **$74.95** (3.45)

Orion® VariPower® 2-3x Multi-Coated Barlow Lens

Our best barlow fills the gaps in your eyepiece collection. Internal lens cell slides easily to adjust magnification. Quality optics provide excellent sharpness, contrast and brightness. Works with 1.25" diameter eyepieces and right-angle diagonals.

#8748 **$69.95** (3.45)

Orion® 3-Element Fully Multi-Coated Barlow Lens

Fully Multi-Coated 3-Element Barlow lens provides superior imaging with precise color correction at three wavelengths. For maximum light transmission and highest contrast, we have used the finest quality multi-coating on each air to glass surface. 1.25" diameter.

#8750 **$64.95** (3.45)

Orion® Deluxe Fully-Baffled Multi-Coated Barlow Lens

Fully internally opaqued and baffled to block stray light for noticeably higher contrast. Large 27mm multi-coated 2-element lens provides 2x magnification with any 1.25" eyepiece.

#8746 **$49.95** (2.98)

Orion® Big Eye™ 8x50 & 11x80 Finder Scopes

You might spend more time viewing through the finder than through your main telescope! Big Eye Scope is ideal for upgrading any telescope including Schmidt-Cassegrains. Available non-illuminated or with wireless, adjustable, battery-operated illuminated reticle and Polaris grid for accurate polar alignment. With 90° diagonal prisms. Optional deluxe dual-ring brackets are perfect for 8" and 10" Celestron or Meade; will fit many others, too.

8x50 Models The 50mm objectives gather 2.7 times more light than 30mm finders!
8x50 Standard Finder #7100 **$89.95** (3.95)
8x50 Illuminated Finder #7135 **$129** (4.19)
Bracket— For 50 mm #5143 **$37.95** (2.98)

11x80 Models These huge finders gulp in over 7 times the light of 30mm finders; 2.5 times more than 50mm models!
11x80 Standard Finder #7146 **$199** (4.71)
11x80 Illuminated Finder #7143 **$269** (5.28)
Bracket— For 80 mm #5140 **$53.95** (2.98)

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1.25" UltraScan Eyepieces

9mm-#8420 **$99** (3.45)

12mm-#8421 **$109** (3.67)

15mm-#8422 **$129** (3.67)

19mm-#8423 **$139** (3.67)

30mm 2" UltraScan Eyepiece

#8424 **$219** (4.71)

40mm 2" UltraScan Eyepiece

Orion's brightest, widest true-field UltraScan eyepiece utilizes a sophisticated 7-element design, providing a 68 degree apparent field, the widest we could fit into the 2" diameter barrel.

#8425 **$199** (3.67)

High Resolution Orion® Ultrascopic™ Eyepieces

Unlike other premium eyepieces, Orion Ultrascopics offer complete multi-layer coatings on ALL surfaces, for superior light transmission and contrast. Modern 5- and 7- element designs for pinpoint star images and breathtaking detail. Wide 52° field of view. Compare with other brands selling for much more!

Wide Field 5-element

35mm #8560 **$99.95** (3.45)

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25mm #8564 **$74.95** (3.45)

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20mm #8566, 15mm #8568, 10mm #8570, 7.5mm #8572

$69.95 ea. (3.45)

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$89.95 ea. (3.45)

Orion® MegaVista™ 1.25" Wide Angle Eyepieces

Incredible Fully Multi-Coated high-transmission 7-element eyepieces with integral rubber eyeguard and long eye relief.

10.5mm—An incredible 67° field for outstanding planetary or deep space performance.

#8552 **$119** (3.67)

16.8mm—Outstanding high-contrast eyepiece with stunning 70° field ideal for deep space.

#8554 **$119** (3.67)

Orion® UltraZoom™ 7-21mm 1.25" Eyepiece

The finest zoom you can buy for your 1.25" telescope. An excellent choice for astronomy or terrestrial observing. 65°-35° field.

#8556 **$139** (3.67)

Orion Plössl Eyepieces!

Orion Multi-Coated Plössl eyepieces are fine performers at an amazingly low price. Precision 4-element Plössl lens elements mounted in sturdy aluminum barrels. Available in 12mm, 18mm, or 25mm focal lengths, with 1.25" barrels. Buy all three for less than some single eyepieces! 12mm-#8596; 18mm-#8597; 25mm-#8598 **$44.95 ea.** (2.98)

Orion® Explorer Series 1.25" Eyepieces

Remarkably affordable, Multi-Coated parfocal eyepieces with great performance. Each carefully selected series has been chosen to provide a sensible progression of magnifications. Threaded for filters. Internally blackened to prevent stray light reflections.

Kellner Eyepieces-

6mm #8536, 9mm #8538, 12mm #8540, 18mm #8508, 25mm #8510, 40mm #8512

$38.95 ea. (2.98)

Orthoscopic Eyepieces-5mm #8500, 7mm #8502, 9mm #8504, 12.5mm #8506, 18mm #8524, 25mm #8526

$49.95 ea. (2.98)

Orion® Explorer Series .965" Eyepieces

Get the most from your small telescope with these fine Multi-Coated eyepieces. Standard .965" barrels fit all Japanese standard small telescopes.

.965" Orthoscopic Eyepieces-

5mm #8580, 7mm #8581

9mm #8582, 12.5mm #8583

$46.95 ea. (2.98)

.965" Kellner Eyepieces

18mm #8584, 25mm #8585

.965" Achromatic Huygenian Eyepieces- 40mm #8586

$33.95 ea. (2.98)

Orion® SkyGlow™ Enhanced Light Pollution Filters

Enhance your viewing of faint deep sky objects with the best broadband light pollution filter you can buy. Our SkyGlow absorbs frequencies emitted by city lights, allowing transmission of the rest of the visible spectrum, yielding dramatic results.

SkyGlow Broadband Filters-Photographic and Visual

For use in slight to moderately light polluted areas.

1.25" Broadband Filter–fits 1.25" eyepieces.

#5660 **$69.95** (3.45)

Schmidt-Cassegrain Broadband Filter–fits rear cell of Meade & Celestron SC scopes.

#5658 **$89.95** (3.45)

52mm Broadband Filter–For 52mm camera lenses, adapter rings available for other diameters.

#5668 **$89.95** (3.45)

SkyGlow UltraBlock Filters–Visual Only

For severely light polluted areas and faint nebulae

1.25" UltraBlock Filter–fits 1.25" eyepieces. #5654 **$99.50** (3.45)

Schmidt-Cassegrain UltraBlock Filter–fits rear cell of Meade & Celestron SC scopes.

#5656 **$139** (3.67)

Orion® Color Filters for Eyepieces

Solar system observations are dramatically improved by Orion colored filters. For visual use, thread one into the barrel of any standard eyepiece. For planetary and lunar photography, Schmidt-Cassegrain owners can attach the filter to the eyepiece inside the tele-extender. Can also be threaded directly into a universal camera adapter.

Basic Set of 4 Filters .965"- Includes #80A Blue, #58 Green, #25 Red, #15 Yellow

#5510 **$34.95** (2.98)

Basic Set of 4 Filters 1.25"- Includes #80A Blue, #58 Green, #25 Red, #15 Yellow

#5514 **$44.95** (2.98)

Expansion Set of 4 Filters 1.25"- Includes #21 Orange, #47 Violet, #11 Yellow-Green, #82A Very Pale Blue.

#5516 **$44.95** (2.98)

Advanced Set of 4 Filters 1.25"- Includes #8 Light Yellow, #23A Light Red, #38A Deep Blue, #56 Light Green.

#5570 **$44.95** (2.98)

Full Set of 12 Filters for 1.25"- Includes Basic Set, Expansion Set, Advanced Set.

#5575 **$119** (3.67)

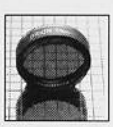
Deluxe Set of 8 Filters 1.25"- Includes all the filters in our basic and expansion filter sets.

#5517 **$84.95** (3.45)

Individual 1.25" Filters- #80A Blue (#11040), #58 Green (#5540), #25 Red (#5536), #15 Yellow (#5532), #21 Orange (#5534), #47 Violet (#5538), #11 Light Yellow-Green (#5530), #82A Very Pale Blue (#5544), #8 Yellow (#5571), #23A Light Red (#5272), #38A Deep Blue (#5273), #56 Light Green (#5274)

$13.95 ea. (2.43)

Moon Filters



Cuts 87% of the light from the Moon. Reduces glare by uniformly reducing light transmitted over the entire spectrum.

.965" #5664 **$14.95** (2.43)

1.25" #5662 **$14.95** (2.43)

Deluxe Eyepiece Case

Organize and protect your valuable eyepieces and other accessories. This durable case with double hinges holds up to 10 eyepieces plus barlow. Die cut foam insert for snug secure fit. O.D. 8-1/2"x12-1/2"x3-1/8".

#5913 **$17.95** (2.78)

Deluxe Metal-Clad Accessory Cases

Keep accessories and camera safe and clean. Diced foam inserts can be tailored to your needs. Sturdy handle, two latches, key.

Regular Case: 16"x12"x6 1/2" #5920 **$59.95** (6.67)

Large Case: 19 1/2"x12"x6 1/2" #5921 **$69.95** (7.10)

Deluxe Field Tripod Tote Bag

Designed for the field tripod with padded insert to separate wedge from tripod during transportation. Specifically made for wedge combinations of Schmidt-Cassegrain telescopes up to 10" aperture. Allows storage without changing polar alignment. This blue bag is made of tear, rip and mildew resistant 100% Cordura nylon.

#15096 **$79.95** (5.19)

Orion® FlexiShield® Dew Caps

Eliminate dew problems with FlexiShield! Better performance, more rugged, and easier storage than rigid dew caps. Forms into a tube with the velcro closure, opens flat for easy storage and transportation. Fits your telescope tube snugly, with wide rubber padding and full length velcro closure—needs no screws. Models to fit most telescopes.

90mm Celestron/Meade Spotting Scopes #4203 **$24.95** (2.78)

90mm Celestron Rubber Armored Spotting Scopes #4205 **$24.95** (2.78)

4" Meade Schmidt-Cassegrain #4204 **$24.95** (2.78)

8" Celestron/Meade Schmidt-Cassegrains #4200 **$39.95** (2.98)

10" Meade Schmidt-Cassegrains #4201 **$49.95** (2.98)

11" Celestron Schmidt-Cassegrains #4202 **$59.95** (3.95)

Orion® Dew Zapper

Orion's Dew Zapper is a sure-fire cure for dew problems on your 8" or 10" Celestron or Meade Schmidt-Cassegrain telescope. Dew Zapper gently replaces lost heat, bringing the corrector plate temperature slightly above air temperature.

8" Dew Zappers- fit all Meade & Celestron 8" Schmidt-Cassegrains

DC Model #3503, AC Model #3504 **$44.95** (2.98)

10" Dew Zappers- fit all Meade 10" Schmidt-Cassegrains

DC Model #3506, AC Model #3508 **$49.95** (2.98)

Dew Remover Gun

Moisture that interferes with viewing dissipates quickly with this 12V DC, 156 watt warm air gun. Has 4-1/2' cord.

#5601 **$17.95** (2.78)

Orion® Slow Motion Adapter

Attaches to your tripod pan head and gives you two slow motion control knobs to make precision adjustments in altitude and altazimuth. Very handy for tracking planets, the Moon, etc. with refractor telescopes and small spotting scopes. Attaches to any camera tripod with a standard 1/4-20 thread.

#7012 **$49.95** (2.98)

Orion® Dual Balance System

Unlike ordinary counterweights, our system allows instant adjustment in both directions. Easily balances your scope to offset both piggyback loads or rear cell cameras, 2" diagonals, and other accessories. Rigid, precision machined dovetail bar mounts to telescope in existing accessory holes.

For Meade SC 8" #5150 **$79.95** (4.78)

For Celestron 8" C-8 #5149 **$74.95** (4.78)

For Meade SC 10" #5152 **$84.95** (4.78)

Starlite Red LED Flashlight

The Starlite is the only adjustable-brightness night-vision red flashlight. Lifetime solid-state LED can't burn out. Extra efficient electronic circuit for long battery life. Uses one 9-volt battery (not included).

#5714 **$24.95** (2.43)

Astronomer's Flashlight

Indispensable and indestructible. Has special night-vision red filter and a diffusion lens for even illumination. An essential addition to your astronomy accessories. Requires 2 D-cell batteries (not included).

#5701 **$9.95** (1.79)

Rechargeable Battery Porta Pac

12 Amp Hour Porta Pac

Ideal for operating your telescope plus higher power-consuming accessories such as an Orion Dew Zapper. Battery is encased in high impact polystyrene. Carrying case of Cordura nylon with shoulder strap and handle. Wt. 10 lbs.

#2354 **$109 ea.** (8.97)

Popular Observer's Chairs

Make observing more comfortable and enjoyable with one of these great chairs.

Standard Model—

Has adjustable height center column and padded vinyl seat. Folds for easy storage.

#5935 **$39.95** (4.70)

Deluxe Model—

Is much heavier-duty, built for professional musicians. Extra thick padding, wide footprint. Adjustable and disassembles for storage.

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Orion® UltraGuider™

Advanced features most requested by advanced deep space astro-photographers at a low price. Use with your Meade or Celestron Schmidt-Cassegrain telescope. Easily adjustable prism allows wider choice of guide stars. Ultra-precise helical focus of your eyepiece, adjustable camera focal plane position.

#5139 **$119** (4.19)

Orion® Premium Off-Axis Guider

Multi-Coated for Peak Performance! Low Orion price for our popular, precision anodized guider.

#5144 **$59.95** (3.45)

Rack & Pinion Focusers

These top quality focusers are designed for Newtonian reflectors. Fit any size tubes.

1.25" Focuser

Quality diagonal-cut rack for smooth focusing. Secure slide-fit eyepiece holder. Integral socket for single-stalk diagonal support if desired.

#13017 **$49.95** (2.98)

2" & 1.25" Focuser

Large clear diameter ideal for larger scopes and wide field optics. Precision diagonal cut rack. Long travel for visual and photographic use. Interchangeable 2" and 1.25" holders with set screws.

#13019 **$89.95** (3.95)

Orion® 45-Degree Erect Image Diagonals

See the world as it really is with Orion's new 45-degree erect image diagonal. Upside-down, backwards and topsy-turvy images can often confuse even the stoutest and most experienced observer. Turn it right-side-up with your choice of three models to select from.

.965 Diagonal #8759 **$69.95** (3.45)

1-1/4" Diagonal #8753 **$69.95** (3.45)

Size-Adapting Hybrid Diagonal #8755 **$69.95** (3.45)

Star Diagonals

1.25" Star Diagonal

Primarily for astronomical use, lets you view at a right angle. Multi-Coated, for 1.25" eyepieces.

#8763 **$39.95** (2.98)

.965" Star Diagonal

Same as 1.25" Star Diagonal, but with standard coated optics. Works with .965" eyepieces and eyepiece holders.

#8761 **$24.95** (2.98)

2" Star Diagonal

Get the widest possible field of view from your Schmidt-Cassegrain Telescope. This star diagonal features a special aluminized and overcoated precision first-surface flat mirror.

#8767 **$99.95** (3.45)

Orion® Tele-Extenders

For high powered photography with your Meade, Celestron 4", 8", 10", 11", 14" Schmidt-Cassegrain.

Standard Tele-Extender

Use this Tele-Extender in conjunction with an eyepiece. Attaches to visual back of Meade or Celestron Schmidt-Cassegrain telescopes, and to 35mm camera with T-ring, sold separately.

#5125 **$27.95** (2.98)

Variable Tele-Extender

Uses an adjustable extension tube, allowing magnification to be changed without switching eyepieces. Attaches with T-ring, sold separately.

#5127 **$39.95** (2.98)

Universal Camera Adapters

Standard Universal Camera Adapters

Combination Eyepiece Projection Tube and Prime Focus Adapter for refractors and reflectors with 1.25" eyepiece holders. Use with T-Ring (sold separately) to match your 35mm camera.

.965" #5268 **$29.95** (2.98)

1.25" #5264 **$34.95** (2.98)

Variable Power Camera Adapter

Unique sliding barrel design allows variable projection distances during eyepiece projection photography, eliminating the need to change eyepieces when magnification changes are required.

#5262 **$44.95** (2.98)

Orion® T-Adapter

For prime focus photography. Use with T-ring to match your 35mm camera. For Meade, Celestron 4", 8", 10", 11", 14" SC. Can be used as 2" camera adapter.

#5116 **$27.95** (2.98)

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DEEP SKY

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Opposite page: Galaxy NGC 2403 photographed by Martin C. Germano (8-inch f/5 reflector, hypersensitized Tech Pan film, 60-minute exposure.

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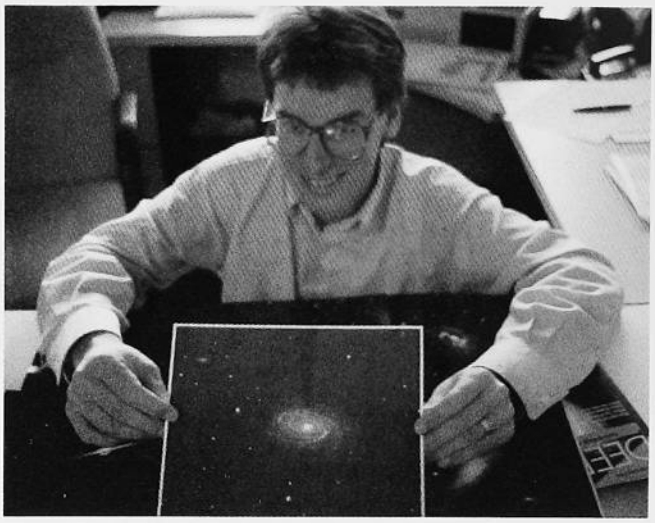
Farewell from Deep Sky

Photo by Richard Berry



Back in the winter of 1975/1976, when I first became interested in astronomy, I fell in love with deep-sky observing. There seemed to be so little written about it that I couldn't get enough. I craved more. The only reasonable solution seemed to be to create a magazine for deep-sky observers and astrophotographers. In June 1977, *Deep Sky Monthly* was born, having rolled off the mimeograph machine in an edition of 125 copies in my father's office at Miami University's Chemistry department. Many of you have been with me since those days back in Ohio; many of you have picked up *Deep Sky* after the publication moved to Wisconsin and became a quarterly in 1982. Throughout all of it, many of you have kept in touch and supported my efforts, enjoyed the magazine and its aims, and helped to make one part of amateur astronomy a fun, lively place.

It is with a heavy heart that I now must inform you that the publication of *Deep Sky* will cease after this issue. For years *Deep Sky* has survived on time and money borrowed from other projects. Now we have reached a point where I am involved in many other duties and responsibilities, cutting the time I could spend on *Deep Sky* from little to none. My increased involvement in the editing and production of ASTRONOMY and duties as Astronomy Books Editor for the company will require great effort in future years. After investigating ways to smooth over the magazine's production, Kalmbach has made the regrettable decision to stop publishing *Deep Sky*.

This is a very sad time for me. Deep Sky has been a partner for fully half of my life, and I have worked hard to make it a worthwhile part of the amateur astronomy community since I was 15 years old. *Deep Sky* has seen me grow from a boy to a man, move from my hometown, get a job, publish my first books, get married, buy a house, and settle into adulthood. It seems most peculiar to think that *Deep Sky* will not be with us over the next 15 years.

Yet I will work hard to incorporate deep-sky related material into ASTRONOMY, publish books of deep-sky interest, and stay active as a promoter of deep-sky observing within the hobby at star parties and meetings. Two new deep-sky books written or edited by me are due out this spring: *Stars and Galaxies; ASTRONOMY's Guide to Exploring the Cosmos* (AstroMedia, Waukesha, 1992), and *Beyond the Solar System; 100 Best Deep-Sky Objects for Amateur Astronomers* (AstroMedia, Waukesha, 1992). *Stars and Galaxies* features contributions by many of the authors you have read in these pages. I hope you will enjoy them. To me these books signify the start of a new stage in publishing quality material of interest to deep-sky observers and photographers.

I want to thank all of you who have supported my work on *Deep Sky*. The authors, artists, and photographers in this field have made producing the magazine great fun, and their talents are well known to us all. The readers of this magazine have been a joy to know, and I hope that I can stay in touch with as many of you as possible in the future. Should I not see you at a future meeting, let's at least stay in touch in the pages of ASTRONOMY.

Thanks to all of you for making a boy's dream come true, and sticking with him through a long, enjoyable, and most interesting journey.

Dave Eicher

Letters to *Deep Sky*

What's Happening in Deep-Sky Astronomy

by the readers of *Deep Sky*

A New Local Group Member

Dear Dave / Another galaxy has recently been confirmed as a member of the Local Group. This is an addition to those featured in my article in *Deep Sky* #36. In the *Astronomical Journal* for July 1991, Fabienne van de Rydt, Serge Demers, and W.E. Kunkel show that the Phoenix Dwarf galaxy is "definitively a member of the Local Group."

The Phoenix Dwarf was discovered in 1975 on an ESO Schmidt plate. It was initially thought to be a very remote globular cluster until plates taken with the CTIO 4-meter telescope in 1976 showed the size to be much larger than its appearance on the Schmidt plate. Its distance was placed at 1,850 kiloparsecs at this time, presumably outside of the Local Group. But using recent measurements of the brightness of its red giants, the 1991 paper puts the distance to the Phoenix Dwarf at only 400 kpc. Based on stellar population, it appears to be in a class that is intermediate between irregulars and spheroidals It is similar in size to Leo II and is about as bright as the Carina Dwarf (read faint!).

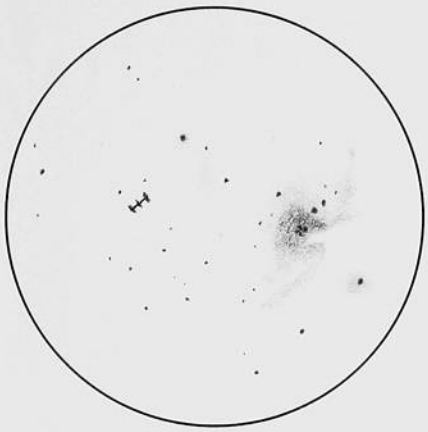
Here are the basic observational data for the Phoenix Dwarf: R.A. (2000.0): lh 51.2m Dec. (2000.0): -44°27' Mag. (V): 13.2 SB(V): 18.4 Dimensions: 17'.4 by 8'.7.

As we are thick in our summer monsoon season here in Arizona, I haven't yet had a chance to observe the field of the Phoenix Dwarf. Given the low surface brightness and magnitude along with its low southern declination, I suspect the prospects are pretty bleak. Perhaps somebody with a large aperture scope in the southern hemisphere will want to give this one a try.

On another matter, Paul Sventek's excellent article in *Deep Sky* #36 motivated me to attempt an observation of an asteroid passage in front of a deep-sky object. In his feature "Asteroid Appulses with Deep-Sky Objects," Sventek gave the specifics of the event involving the asteroid 148 Gallia and the Orion Nebula. Although M42 is nowhere near the ecliptic, the great orbital inclination of 148 Gallia of over 25° brings its path into southern Orion.

I viewed the event on the morning of September 17, 1991, with a 13-inch telescope from my backyard in suburban Phoenix. The accompanying drawing shows the murky appearance of M42 and the positions of the asteroid as it moved from left to right (west to east) at 10:50, 11:20, and 12:00 U.T. At 12th magnitude, the asteroid was easily visible as it was well away from the bright glow of the region around the Trapezium. Its motion was detectable in only 10 minutes as it moved along at nearly one arcminute per hour.

As asteroid observations are often easily made from urban locations, it would be great to see more articles about these shallow sky objects appearing on the pages of this magazine. — *Tom Polakis, Tempe, Arizona.*



Asteroid 148 Gallia passing M42 on September 17, 1991. Sketch by Tom Polakis.

The Companions of NGC 7331

Dear Dave / I found the excellent picture of NGC 7331 and its companions in a Ron Morales article in the September 1991 *Sky & Telescope* the day after I observed the group. The timing was good since I hadn't been able to locate NGC 7325. Jeff Corder and Steve Gottlieb presented an excellent discussion of the companions in the Fall 1986 *Deep Sky* which showed that NGC 7325 and NGC 7326 were actually double stars that the original observers mistook for faint galaxies.

We had no problem finding Morales' Anon 1 (Zwicky 514.066), easier than its magnitude of 15.7 would indicate. However, our sketch showed one of the brightest field stars exactly at the location of Anon 2. A closer look at the picture, to me, indicates a bright field star superposed on a faint galaxy. Notice that the fuzz can only be seen on the left side of the star image.

If this diagnosis is correct then the *RNGC* description will have to be updated. Equally as important, a successful visual observer will probably require a driven telescope at high power, with an occulting bar in the eyepiece. Can anyone meet this "ultimate" challenge? — *Alister Ling, Edmonton, Alberta, Canada.*

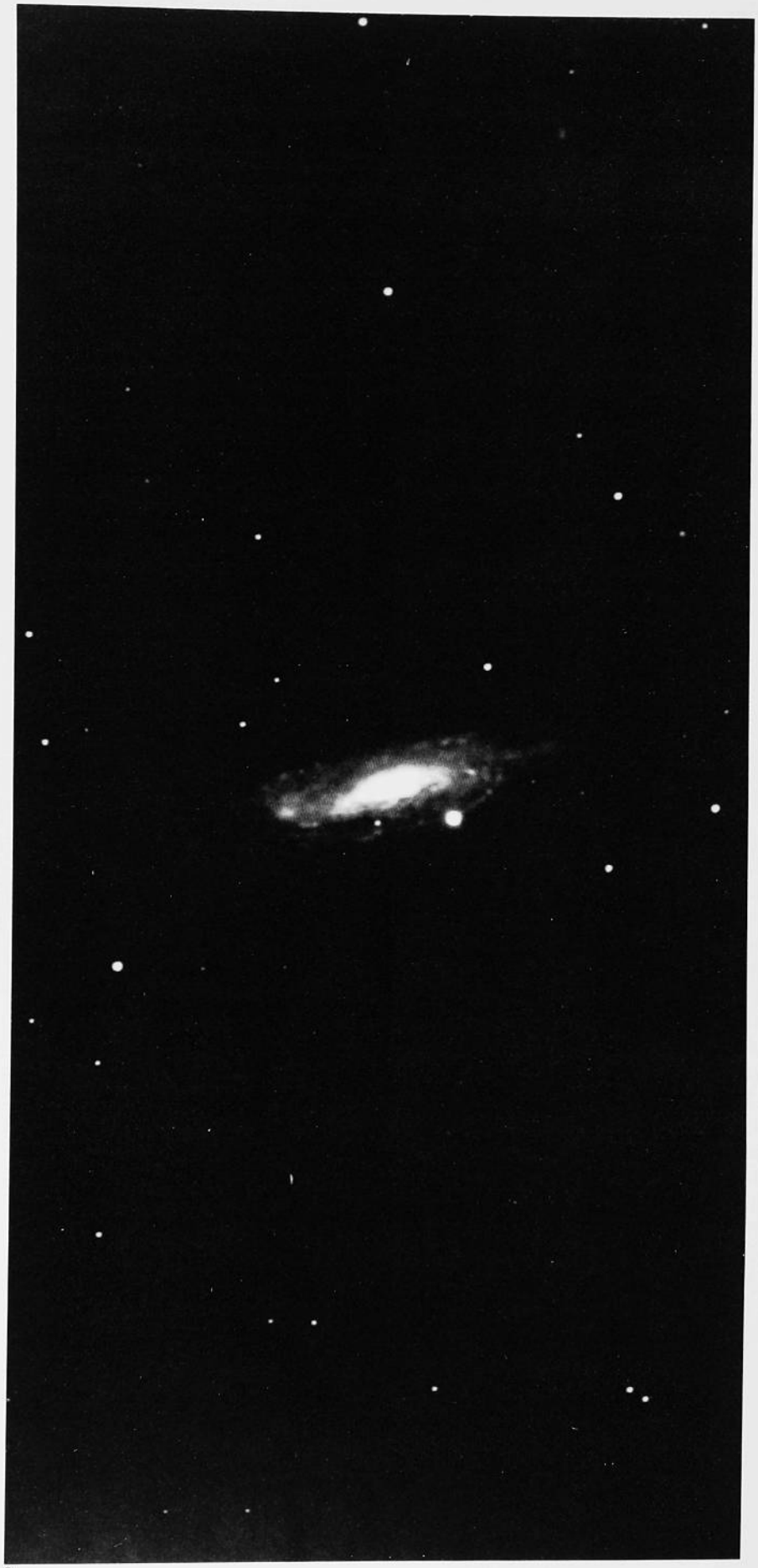
A Bright Supernova

Dear Dave / Here are the data and light curve, plus some photos, of the bright Supernova 1991T in the galaxy NGC 4527. The data were gleaned from the *IAU Circulars* plus many unpublished magnitude estimates from collegues in Spain, Australia, and here in the U.S. Several of these estimates were sent to Brian Marsden, but he chose not to use them. I have also included a copy of the light curve from Supernova 1989B to show the some disparities between the two events.

I would not venture to evaluate the event at this time except to say that the inflection point (point of rapid decline yielding to a more slow decay) was rather late visually for this supernova compared to that of 1989B. However, the mean decline seems to almost coincide at later dates. I am almost certain that the combined foreground reddening of this galaxy plus the color excess of the event will also be a factor in its final determination. — *Steve H. Lucas, Midlothian, Illinois.*

Shooting the Faint Ones

Dear Dave / Your comments keep me vigilantly searching for interesting, yet, not commonly photographed deep-sky objects. I enclose four photos, the first being a photo of NGC 6951, an Spb I-II type galaxy in Cepheus. This 240 minute (4 hour) exposure was shot through a C-11 at f/11 on Hypered Tech Pan 2415 film at 68°F in D-19 for 8 minutes. I was inspired to shoot this galaxy

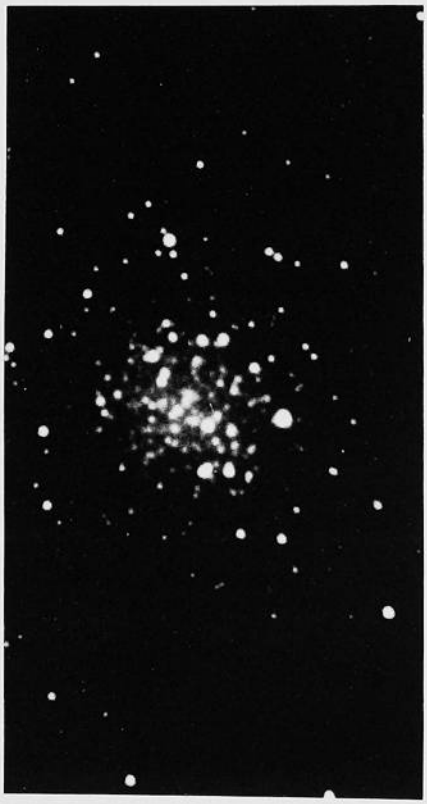


Left: Supernova 1991T in galaxy NGC 4527 photographed by Kim Zussman (14.5-inch f/8 Cassegrain, hypersensitized Tech Pan film, 100-minute exposure on May 12, 1991.

Above: The same object photographed two nights earlier by Michael Stecker (14-inch SCT at f/6, hypersensitized Tech Pan film, 90-minute exposure.

from the excellent picture of it that was shown in the Summer 1990 *Deep Sky* on page 20.

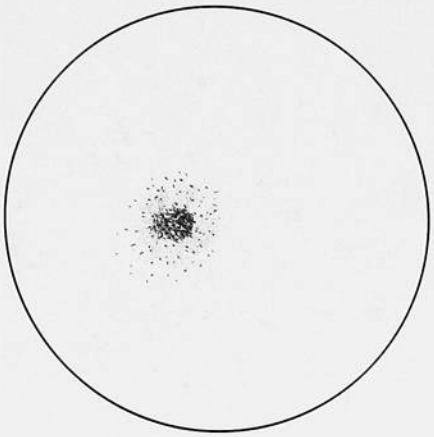
Although my picture does not show the nuclear detail as well and has larger stars, it seems to show all the stars in the reprint of the USNO shot in *Deep Sky*. This galaxy is well placed for summer and autumn viewing. I wonder if



Odd galaxies and clusters photographed by James R. Foster, clockwise from top: NGC 6951 (11-inch SCT at f/11, hypered Tech Pan film, 240-minute exposure); NGC 6097 (11-inch SCT at f/11, hypered Tech Pan film, 161-minute exposure); NGC 6144 (11-inch SCT at f/11, hypered Tech Pan film, 60-minute exposure); M74 and asteroid 88 Thisbe (11-inch SCT at f/7, hypered Tech Pan film, 37-minute exposure).

anyone with a large reflector has viewed spiral structure of this 3.8' by 3.3' barred spiral galaxy?

The second photo shows the globular cluster NGC 6144 in Scorpius. It is



Globular M10 sketched by Bill Johnson with an 8-inch f/4.5 reflector at 144x.

(visually) a magnitude 9.12, Class 11 type globular, 9.3' in diameter. It lies between and slightly above a line drawn from Antares to the globular M4. Although its absolute magnitude is slightly less than M4's, Mv = -6.57 *vs.* -6.80, NGC 6144 is about four times as distant as its brighter neighbor. It is also an older globular cluster than M4, judging by its large metallicity [Fe/H] index. Stars that are older than the Sun have a greater difference in the chemical ratio of iron atoms-to-hydrogen atoms. These stars were born when the universe was not yet old enough to have many stars enriched by the interstellar medium with elements heavier than helium. Through stellar wind, nova and supernova explosions, succeeding generations of stars have been enriched with the elements heavier than helium by nucleosynthesis in the centers of massive stars. NGC 6144's metallicity index is -1.75, while M4's is about -1.33. A star with an Fe/H index of -2 contains 1/100 as many iron atoms to hydrogen atoms as our Sun.

The third shot is of NGC 6907, a bright S(B)b galaxy in Capricornus. It has an interesting S-type spiral pattern and looks like a more distant version of the galaxy NGC 1300 in Eridanus; its relative velocity is twice that of NGC 1300. Its nucleus is less round and more boxed shaped than NGC 1300. This shot was also taken with a C-11 at f/11, on hypered Tech Pan, for a 161-minute (2.67 hour) exposure.

The fourth picture shows M74 & the trailed image of asteroid 88 Thisbe. This 37 minute exposure was taken on July 12.47 UT. — *James R. Foster, Hollywood, California.*

Conflict of Star Charts

Dear Dave / I'm writing concerning Ted Aranda's letter of complaint in the Summer 1991 *Deep Sky* about Mark Coco's review of Tirion's *Bright Star Atlas 2000.0*. What atlas was Mr. Aranda looking at? Every *Bright Star Atlas 2000.0* we have in our store has quite visible and legible markings in the Milky Way portions of the charts, where the black symbols and printing are on a light green background. While it's true that the Milky Way symbols don't stand out with quite as much snap under red light as the black on white symbols of the adjacent non-Milky Way areas, they do not become "invisible" under a red light. — *Fred Bieler, Norman, Oklahoma.*

Observing Ophiuchus

Dear Dave / I would like to share some observations that I made a few nights ago. I made these observations from sunny Southern California. The smog and light pollution was limited that night. I used a 8 inch Newtonian.

The objects I observed were in the central part of Ophiuchus. I will begin with the globular cluster M14, a nice globular that is somewhat bright but seems to have a low surface brightness. I noticed some resolution around the edges. Next comes the globular I was amazed to see: Palomar 15. It is listed in *Uranometria* on page 247. I really did not expect to see it, but *there it was!* It appeared as a pretty faint, circular glow. Has anybody out there seen this globular?

A small but bright planetary nebula also lies in the area. NGC 6309 is rectangular in shape and takes power well. Last is M107. It is a pretty low surface brightness globular but still shows some structure. All these observations were made with high to medium powers. — *Bill Johnson, Rialto, California.*

Fornax Dwarf Globular Clusters

Dear Dave / I was pleased to see Gerd Bahr-Vollrath's observations of the little known Fornax dwarf globulars in the Summer 1991 *Deep Sky*. Gerd's article described three of the five known globulars but did not provide identifications, positions or magnitudes. The four brightest of these globulars should be visible in a 10-inch or 12-inch scope from a dark North American site.

E356-SCOI (designation from the ESO-Uppsala Catalogue) is located at 2h38.7m -34°49' (equinox 2000) and described by Gerd as object #1. This one is the faintest (13.5 V) of four globulars seen with my 13.1-inch scope. A pretty double star in the field to the northwest will guide you to the right spot.

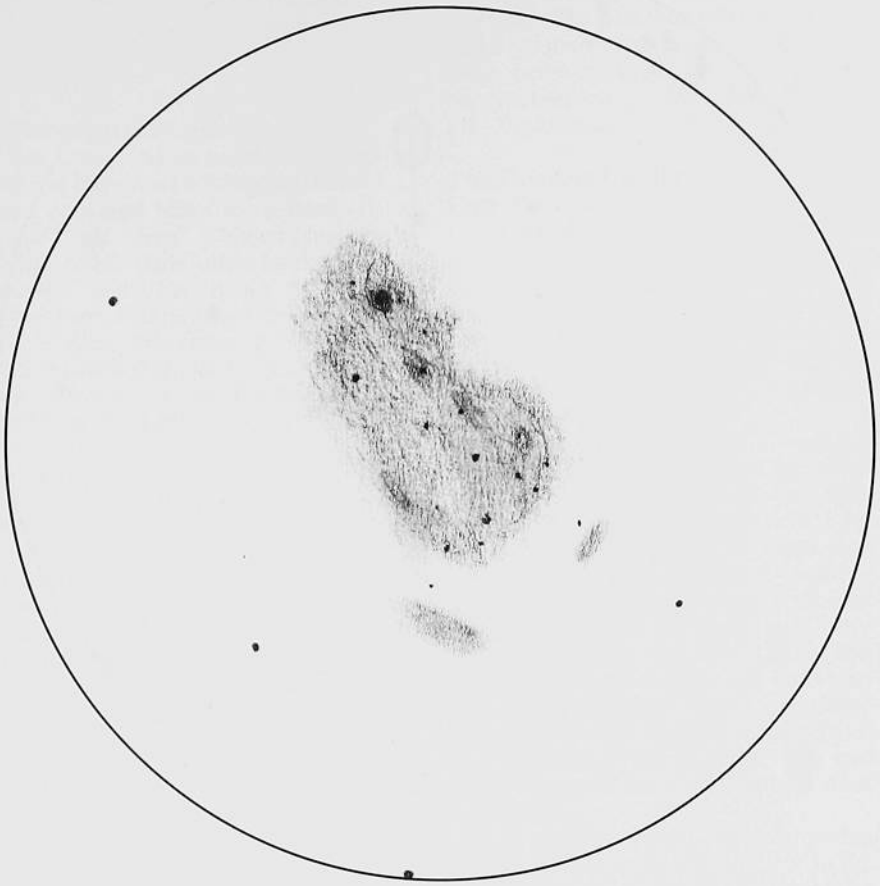
John Herschel discovered NGC 1049 from the Cape of Good Hope on October 19, 1835, but was puzzled by its classification. His notes mention "like a star of 12th magnitude a little rubbed at the edges, a curious little object and easily mistaken for a star, which, however, it certainly is not." Visually, I'd place its magnitude closer to 12.5 but only 30" in diameter. This one is plotted on *Uranometria* and should be the first one you run into.

Globular #3 mentioned by Gerd is E356-SC05, located at 2h40.1m -34°32' (2000). Although only 20" across visually, just point your scope at the 8th-magnitude star superposed in the center of the galaxy. E356-SCO5 will be found glowing weakly at magnitude 13.6 V, just 7' east.

Finally, Gerd missed the second brightest globular in the system, E356-SC08, located outside the eastern edge of his sketch at 2h42.2m -34°06' (2000). An easy way to center this object is to offset 10' north from NGC 1049 and then just let your scope drift for 2.7 minutes. You should find a 13th-magnitude, 30"-diameter fuzzball with a bright core floating through the field. Perhaps you can provide a photo of the Fornax Dwarf with the globulars labeled. An article with an excellent photo taken with the Baker-Schmidt telescope at Boyden Observatory appeared in the December 1964 issue of *Sky & Telescope*. — *Steve Gottlieb, Albany, California.*

Dear Dave / Hats off to Gerd Bahr-Vollrath for drawing attention to the Fornax Dwarf globulars in the summer issue. I first learned of them from the Webb Society's *Deep-Sky Observers Handbook*. For years, I was determined to see them, but without an adequate finder chart the task proved impossible. Finally, last November, with the help of a photocopy of the field sent to me by Steve Gottlieb, I managed to positively identify NGC 1049 and two others.

Bahr-Vollrath should be interested to know that there are five globulars in this area and they were catalogued by Paul W. Hodge in 1961. This listing is included in the MOL. NGC 1049 is also known as Hodge 3, while the globulars designated No. 1 and No. 3 in the article are Hodge 2 and Hodge 4 respectively. Back in November, I failed to see Hodge 2, but did observe Hodge 5 which is the easternmost of these clusters. Hodge 1 is extremely faint and may not be visible under the best of conditions. I'm including a sketch of the four brighter clustrers positions which should aid in their observation.



Galaxy NGC 4449 sketched by Randy Pakan using a 16-inch f/5 reflector at 420x.

— *Ernie Ostuno, Cheshire, Connecticut.*

Dear Dave / I read with interest Gerd Bahr-Vollrath's successful observation of globular clusters in the Fornax Dwarf Galaxy. Having recently searched through professional literature for information on galactic globulars, I recalled at least one reference to a total of six Fornax globulars. Having not observed these objects myself, I had, sometime ago, placed them on a mental list to do so whenever conditions and available equipment warrant it.

The best source I found was a catalog listing by Ronald F. Webbink of the University of Illinois. Even though Webbink appears to have some questions about the accuracy of the surface brightnesses for five of the six clusters, he also points out that these surface brightnesses were obtained using concentric aperture photometry, the perferred method, meaning that they shouldn't be ignored just because of the poor quality of the data. Also, it should be pointed out that the above cited core radii are model dependent — they have been calculated by using a mathematical formula rather than an actual measurement from a photograph.

It is most interesting to note that all but one of these objects appear to have surface brightness that is brighter than that of a true dark night sky, or 13.1 V magnitudes per square arcminute (see Brian Skiff's column in *Deep Sky* #33, #34, and #35). This is even more important when, as Brian points out, it is possible for the human eye to see objects that are even fainter than the night sky.

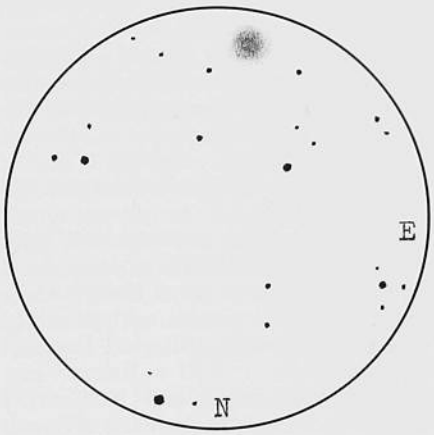
So, gauging from this information, I'm guessing that all six of these objects may be visible in amateur telescopes, especially if they are observed from southern altitudes. Perhjaps one key might be to use higher magnifications becasue of the small size of these objects. Indeed, Skiff and Luginbuhl in *Observing Handbook and Catalogue of Deep-Sky Objects* report on observing two fo the objects with a 6-inch (15cm) telescope and four of these clusters using a 12-inch (30cm) telescope. — *Robert Bunge, Laurel, Maryland.*

The Mystery Object

Dear Dave / Gregg Thompson's mystery object offered in *Deep Sky* #33 apparently represents NGC 6752 in Pavo, a striking object when viewed through instruments ranging from binoculars to large aperature telescopes.

The impression of one globular cluster superposed upon another larger and fainter globular matches well the view presented through my 6-inch f/8 Newtonian.

My observing notes for 1977 portray a large, brignt globular in which resolution is obvious throughout. Stars within the cluster seem to occupy two distinct levels of brightness, a number of the 9th and 10th magnitude overlying innumerable stars of magnitude 12 and fainter. Outlying members stretch the cluster's diameter to about 10' but the striking feature is a brighter central region 3' across from which stars seem to radiate in a loose spiral pattern. The



Globular Palomar 8 sketched by Miro Ilac with a 6-inch reflector at 140x.

ease of resolution places NGC 6752 in company with five other great southern globulars: NGC 104, NGC 5139, M4, NGC 6397, and M22.

My notes for this object do not, however, make reference to color apart from stating that all stars appeared white in color. Experience has taught for my particular observer/telescope combination I cannot expect to see subtle star colors fainter than 8th magnitude except for distinctly red stars in which color perception ceases a little fainter than the 9th magnitude.

Another of Thompson's mystery objects (*Deep Sky* #28) has had me intrigued for some time and apparently drew no response from readers. The cluster presented there is, I feel, NGC 3532 but the text reference to the Palomar Schmidt Plates would then be in error. Should this actually refer to plates obtained at one of the southern Schmidts in Austarlia or Chile? NGC 3532 is a delightful cluster situated in the rich southern Milky Way of Carina

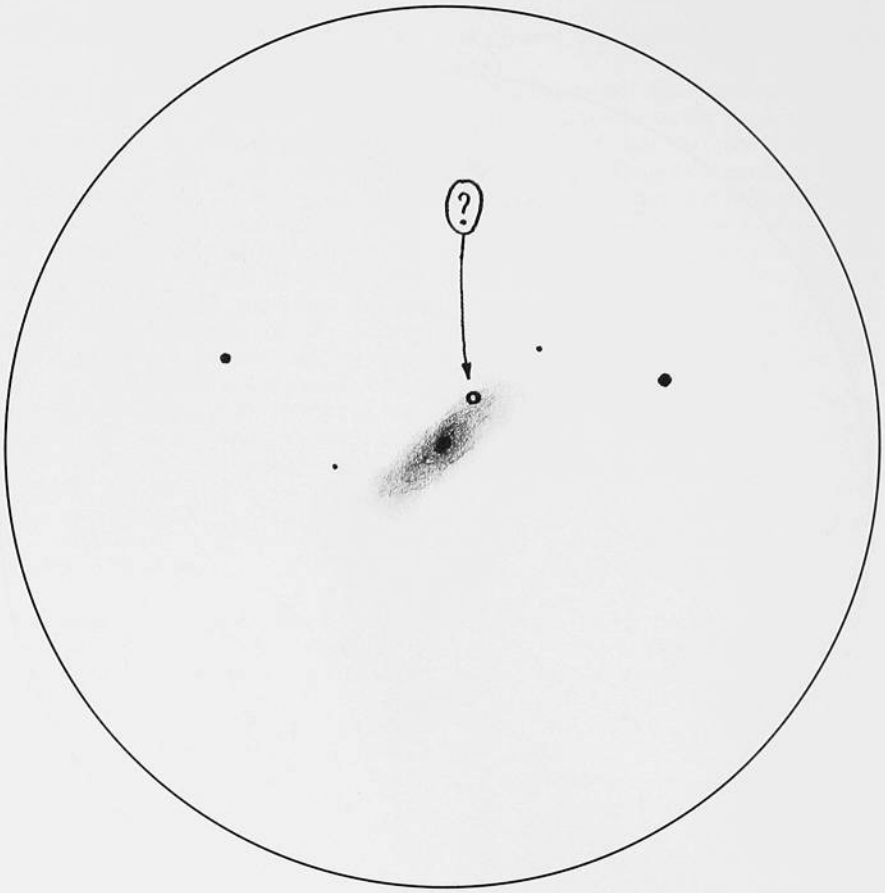
and is clearly visible to the unaided eye as a distinct nebulous patch 2.5° east of the brilliant Eta Carinae Nebula complex. It has a large apparent diameter, about 50', and often appears more striking in smaller aperature low power telescopes which are capable of including more of the surrounding sky, thus giving better contrast.

Seen through a telescope, NGC 3532 is a very large, bright and rich cluster of stars of magnitudes 7 to 13, most of which appear white in color. In fine contrast is the beautifully orange colored HD96918 (V = 3.9) lying on the cluster's southeastern edge. A broad central concentration measuring 30' by 15' within the cluster has a single orange star, HD96544 (V = 6.0) situated on its north eastern edge. Many starchains are found running in all directions across the cluster and several pairs are also evident.

Two somewhat vacant areas are found near the cluster's central region as portrayed in Thompson's drawing. The richness of this cluster is fully appreciated when the telescope is slowly swept 2° or so to either side of the center.

A well defined and extensive dark nebula lies a little north of NGC 3532 and extends westward to the Eta Carinae complex, a feature well shown to binocular observers if the sky is relativery dark.

Both NGC 6752 and NGC 3532 should be included in any list of "don't miss" objects for those from the north heading down under to explore the southern skies. — *Peter F. Williams, New South Wales, Australia.*



The discovery sketch of Mirko Villi and Giancarlo Cortini showing Supernova 1991T in the galaxy NGC 4527. Sketch made on April 15, 1991, with a 10-inch SCT at 155x.

To Discover a Supernova

Dear Dave / Our names are Mirko Villi and Giancarlo Cortini; we are both subscribers of *Deep Sky* since a few months ago.

We are very glad to receive your wonderful magazines because we are deep-sky observers since 1981 and now we can say, also, to be happy for our codiscovery (with S. Knight and R. Evans) of Supernova 1991T in NGC 4527 during the night of 15 April 1991, after many hours and days of searching. We are the coordinators of the national program of extragalactic supernovae visual searching since 1990 and surely we could not think to discover a supernova so soon, because this happens, generally, after some years of searching.

During the night of 15 April we were, of course, not sure about the nature of the "guest" star near the galaxy and, as we do usually, we made a simple drawing of NGC 4527 and the field around it.

We should like to know about the possibility to send you the descriptions and drawings of our deep-sky observations. — *Villo Mirko and Cortini Giancarlo, Forli, Italy.*

A Really Strange Galaxy

Dear Dave / I had one night in April when the sky was more transparent then usual. The structure I was seeing in galaxies was a real treat. Here is a sketch and observation of NGC 4449 that I spent a good deal of time on. The photo of it in *Burnham's* shows it as an overexposed blob. This galaxy takes power beautifully and has a wealth of detail. It would be a great object for reader feedback. — *Randy Pakan, Edmonton, Alberta, Canada.*

Is the Author Unmasked?

Dear Dave / I don't agree with the Chris Schur paper on unsharp masking (*Deep Sky* #36). The technique of unsharp marking is an old one (used in France for more than 40 years). The technique was published several times, but not very well (*A Manual of Advanced Celestial Photography* by B. Wallis and R.W. Provin, as an example). I think Mr. Schur's technique is wrong. The basis of the unsharp masking is to use a low contrast film developed in a diluted developer to obtain a very low contrast print. Malin and Murdin use Kodak commercial film 4x27 developed in D76 (very diluted: 1:3) or only 2.5% Ilfosped. This is a very important point. I use Kodak fine grain positive 35mm film and a very diluted Dektol developer.

Schur here introduced a revolutionary new method using very high contrast masks (Tech Pan and D19). I don't agree with this. His photographs are overmasked. As he wrote, the Lagoon Nebula shows a dramatic difference, but to my knowledge nobody has ever seen a black hole in it. Malin and Murdin have published a much better version. The Orion Nebula by Bruce McDonald is a good sample of much better sample of unsharp masking (but I think is undermasked and the Orion photograph I send to you is a better sample). M31 doesn't need masking, but the Paul Lind masking is correct. The Chris Schur NGC 1973-7 and Trifid are overmasked.

The Chris Schur modified unsharp masking technique is easier to do for the amateur but will give distorted re-

sults. In fact it is very difficult to do good unsharp masking of the best astrophotographs, as Malin does. — *Jean Dragesco, Saint Clement de Riviere, France.*

Who's Got the Little Gem?

Dear Dave / As an amateur astronomer who is interested in planetary nebulae, I was confused when some books listed the "Little Gem" planetary nebula as NGC 6818 while other books listed it as NGC 6445. Five books, *Amateur Astronomers Catalogue*, *The Deep Space Field Plan*, *The Observer's Handbook*, *The Visibility of Deep Sky Objects*, and the *Peterson Field Guide* list NGC 6818 as the Little Gem. Three books, *Sky Catalogue 2000.0*, Vol. 2, *NGC 2000.0*, and *Deep Sky Name Index 2000.0*, listed the Little Gem as NGC 6445.

This confusion was resolved because the editors of *Sky Catalogue* were good enough to reference the sources of the names they listed (this is definitely to their credit). They referenced the *Observer's Handbook* as the source for the Little Gem. When I looked it up it became obvious what had happened. NGC 6818 is listed as the Little Gem under "The Finest NGC Objects" in the *Observer's Handbook* and the line just above it is NGC 6445. It was just a simple mistake of going to the wrong line which lead to the Little Gem being listed as NGC 6445 in *Sky Catalogue 2000.0*, Vol. 2. So if any of the readers of *Deep Sky* are confused as to the correct NGC number for the Little Gem it is definitely NGC 6818. For the curious, the name Little Gem was coined by the late John H. Mallas in ASTRONOMY (August 1977, page 44). — *Kent Wallace, Atascadero, California.*

Bunge's Globulars

Dear Dave / As always, I greatly enjoyed reading the spring issue. I was glad to read article about globulars in Sagittarius by Robert Bunge. It is a nice summer project for amateurs.

Here I will add small notice concerning Palomar 8 globular. Robert stated, "I found it a challenging object in a 31-inch at 200x." Well, I do not know what is going on, but Palomar 8 is relatively easy visible in a 5.5-inch telescope from my suburban location. During clear and transparent nights, it is much easy object than few NGC globs in Ophiuchus. It is a faint, fuzzy round spot best seen at medium power by averted vision. Three stars of 8 magnitude guide to it.

Enclosed is a sketch with the 5.5-inch scope at 140x. As advice to beginners I will use a word my astro-buddy Bill Clarke from San Diego said, "do not strongly believe to everything you read. The best way is to get out and make your own observation." But I always believe *Deep Sky* is a must for every observer. — *Miro Ilic, Dubrovnik, Yugoslavia.*

The Palomar Clusters

Dear Dave/ In the Spring 1988 issue (*Deep Sky* #22), David Higgins provided a fascinating article on the visibility of the Palomar globular clusters. In the article, which describes Higgins' successful observation of five of them, he states that he was using a 24-inch f/4 telescope but that users of 12-inch telescopes might pick them up.

In working through *Sky Catalogue 2000.0*, I had already picked up a few of the brighter Palomar clusters with my C-11. Intrigued by the article, I set out to observe as many of them as I could. Last year I completed observations of all 15, though some were just on the threshold of visibility. Since then I have gone over the list again and reconfirmed and redrawn all but Palomar 2 and Palomar 3 (still not above my horizon), and Palomar 12 and Palomar 13. Last night I tried the latter two but I was uncretain as to whether or not I saw them.

One of the problems I encountered in the list in *Deep Sky* was an error in the coordinates for Palomar 11: it should-have been -8°02'. Also, when I was looking up references in the *Master List of Nonstellar Astronomical Objects*, several of the globular clusters were listed as open clusters. To further complicate things, corrections printed in *Uranometria*, vol. 2, indicated the symbol for Palomar 4 should be changed from a globular cluster to a galaxy. — *Lucian J. Kemble, Lumsden, Saskatchewan, Canada.*

Satisfied Customer

Dear Dave / I've been meaning to write you for some time to tell you how much I enjoy *Deep Sky*. It is surely the best magazine for deep-sky observers. I especially enjoy articles dealing with seldom-observed objects such as the one in *Deep Sky* #36 covering the Local Group. The cover photo (NGC 205), the photo on page 15 (NGC 185), and the contents page photo (NGC 6822) were intriguing because they showed a great amount of detail in these objects. The sketches of different objects are great, too, because they afford the chance to compare my observations with those of others. Incidentally, congratulations on your work *Deep Sky Observing with Small Telescopes*. It is outstanding and just what I needed!

I've always felt a certain kinship with you and your readers because of my background in amateur astronomy. Discovering ASTRONOMY magazine as a high school freshman in 1976, was one of the most exciting times of my life. I have not missed an issue since. I was soon outside with a 6-inch Newtonian and couldn't get enough. Anyway, I thought I would share a few observations I've made over the years. Being under truly dark skies on the Mississippi River in 1982 was a real eye-opener — seeing 48 galaxies in the Virgo cloud in one night with my 6-inch scope was a special treat. Camping on Lake Shelbyville in central Illinois and scanning the magnificent Milky Way with binoculars was awesome. Lately I've been able to share my passion for astronomy with a number of friends and feel a special thrill when they first see Saturn or a globular cluster and then talk about it for weeks.

Thanks for all you have done and continue to do for amateur astronomy. — *Joe DalSanto, Hanover Park, Illinois.*

The National Deep Sky Observers Society is Looking for You

Dear Dave / With *Deep Sky* ceasing publication, the undersigned wants to make readers aware that there is an organization for deep-sky observers. The National Deep Sky Observers Society was founded in 1976 to serve deep-sky gazers. The NDSOS provides a number of services to its members:

•Our publication *Betelgeuse* is entering its 17th year. Its primary function is to disseminate information, observations, and club news. We are in the process of changing the journal from a bi-monthly to a quarterly.

•Another publication, *The Practical Observer*, will be used to cover techniques, equipment, and other "how-to" articles.

•We publish an annual membership directory that enables observers with similar interests to correspond with one another.

•We are initiating an awards program.

•Answers to questions and access to professional catalogs are available through our Data Information Service.

•We are working on a book of observations and photographs of nebulae.

•We have recently begun a discount program for astronomical equipment purchased from manufacturers.

Anyone interested should contact the undersigned, or: Murray Cragin, NDSOS Membership Coordinator, 26 Maple Avenue, Shalimar, FL 32579. — *Alan Goldstein, NDSOS National Coordinator, 1607 Washington Blvd., Louisville, KY 40242.*

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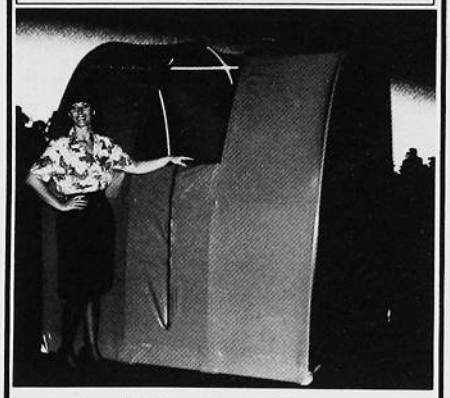

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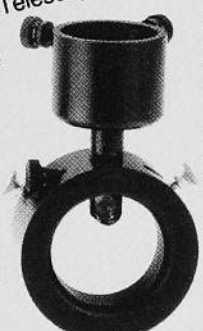

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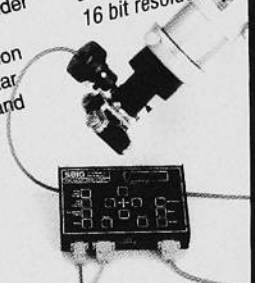

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Observing the *M81* Galaxy Group

by Tom Polakis

Like stars, galaxies are gravitationally bound to companions in the heavens. Much as our Milky Way Galaxy is a member of the Local Group, most galaxies that amateurs observe belong to larger-scale gatherings. Astronomers are beginning to see evidence of larger and larger scale structures, and in one of the large galaxy aggregations known as the Coma-Sculptor Cloud lies our own Local Group and its neighboring galaxy groups. Examples of neighboring galaxy groups appear in the constellations of Sculptor and Ursa Major. It is the later assemblage, also known as the M81 group, that we will discuss.

Local Group galaxies are found within a sphere 3 megaparsecs (Mpc) in diameter whose center lies between the Milky Way and M31. It is outside this sphere that we begin to see evidence of cosmological expansion in the spectra or galaxies. M81 group galaxies were the first outside of the Local Group in which the light curves of Cepheid variables in conjunction with redshirt data were used to home in on the elusive Hubble constant. These measurements have placed the distance to the center of the M81 group at 3.25 Mpc, or approximately 10 million light-years.

Membership in the M81 group is confirmed only when The distance to the suspected member is shown to be near that of M81. Distance estimates can be subject to interpretation, however, since many galaxies in this regime do not have bright Cepheid variable stars to use as standard candles. For this reason, there are about as many different M81 group membership lists as there are sources. Erik Holmberg (1950) first defined a list of fifteen M81 group members. This list has been revised many times since. Recently, the team of Karachentsev, Karachentsev, & Bîrngen (1985) photographed 37 additional dwarf galaxies near M81 with the Soviet 6-meter telescope, resolving many of them into stars on the plates. For our discussion, we'll focus on the list of fifteen definite members whose velocities have been measured, adopted from the *Nearby Galaxies Catalog* by R. Brent Tully (1987a). This catalog is intended lo be a companion to the masterful *Nearby Galaxies Atlas* (Tully & Fisher 1987), a multi-color collection of maps that gives an excellent three-dimensional representation of The large-scale structure of the nearby universe.

Complementing these two works is an article in the *Astrophysical Journal* by Tully (1987b) assigning the 2,367 galaxies plotted in the atlas to clouds, associations, and groups. Groups, such as the one found around M81, are simply small concentrations in larger features called associations, which in turn are part of still larger-scale structures called clouds. By performing an exhaustive analysis of their velocities, Tully was able to show that 64 percent of the galaxies in the sample lie in groups and only 1 percent of the sample are "at large" and not even associated with clouds.

For the visual observer, the M81 group presents a wide range of galaxies from star-party favorites to obscure dwarfs, barely visible on the *Palomar Observatory Sky Survey* (*POSS*) prints. A key to seeing the most detail in these objects, particularly in the faint dwarf galaxies, is to use the whole range of telescopic magnifications. The fainter galaxies often disappear from view at either too-high or too-low magnifications. For the lowest-surface-brightness objects, a tape recorder allows one to take notes without exposure to the red flashlight. A lesson about objects at high declinations: if you are using a large Newtonian on a German equatorial mount, be prepared to rotate the tube! Over a half-hour observation, the eyepiece height change on my 13-inch scope would result in beginning the observation crouching and finishing it standing on tip-toes.

Working our way from the brightest to faintest members, Let's take a tour of the M81 galaxy group. At the heart of the thirteen galaxies is none other than **M81** (NGC 3031). It is a classic example of an Sb spiral galaxy, with thin but well-defined spiral arms around a large nuclear region. Both in photographs and through the telescope, M81 resembles M31, the Andromeda Galaxy, another Sb spiral. M81 has proven to be an excellent nearby specimen for testing theories of spiral arm formation. Spiral structure in a galaxy cannot be explained by the same simple mechanism as that of cream stirred into your morning cup of coffee. Over time, the arms would wrap many times around the nucleus instead of just once or twice as is typically observed. The theory of density waves proposes that galactic spiral structure is a result of accumulation of material along the intersection or elliptical paths defining the orbit of stars, dust, and gas (Kaufman, 1987). Observations in the infrared and radio portion of the spectrum have supported the theory of density waves with the detection of HII regions in the arms and the smooth-to-ragged transition from the inner to outer portions of the arms.

In my 13-inch scope working at 75x, the initial impression of M81 is of a disk whose overall dimensions are 15' by 7' in position angle (p.a.) 150°. There is a very bright central glow surrounded by a core 5' by 3' in size whose brightness falls off linearly. The spiral arms are subtle but discernible. The

Galaxy M81 photographed by Bill and Sally Fletcher (16-inch f/4.5 reflector, hypersensitized Tech Pan film, taken on December 14, 1990, from Mt. Pinos, California.

eastern arm can be seen more easily as it bears off the south end of the galaxy. A couple of the brighter stellar associations can be seen in this arm at the south end of the galaxy and due east of its nucleus. The western arm has a much thicker and less welldefined appearance. A magnification of 165x showed the nucleus to be nonstellar. At 215x the appearance of the core region is similar to an elliptical galaxy elongated 2:1. The most striking difference from photographic images is differentiating the thick spiral arms from a small nuclear region, where photographs almost always burn this central area out.

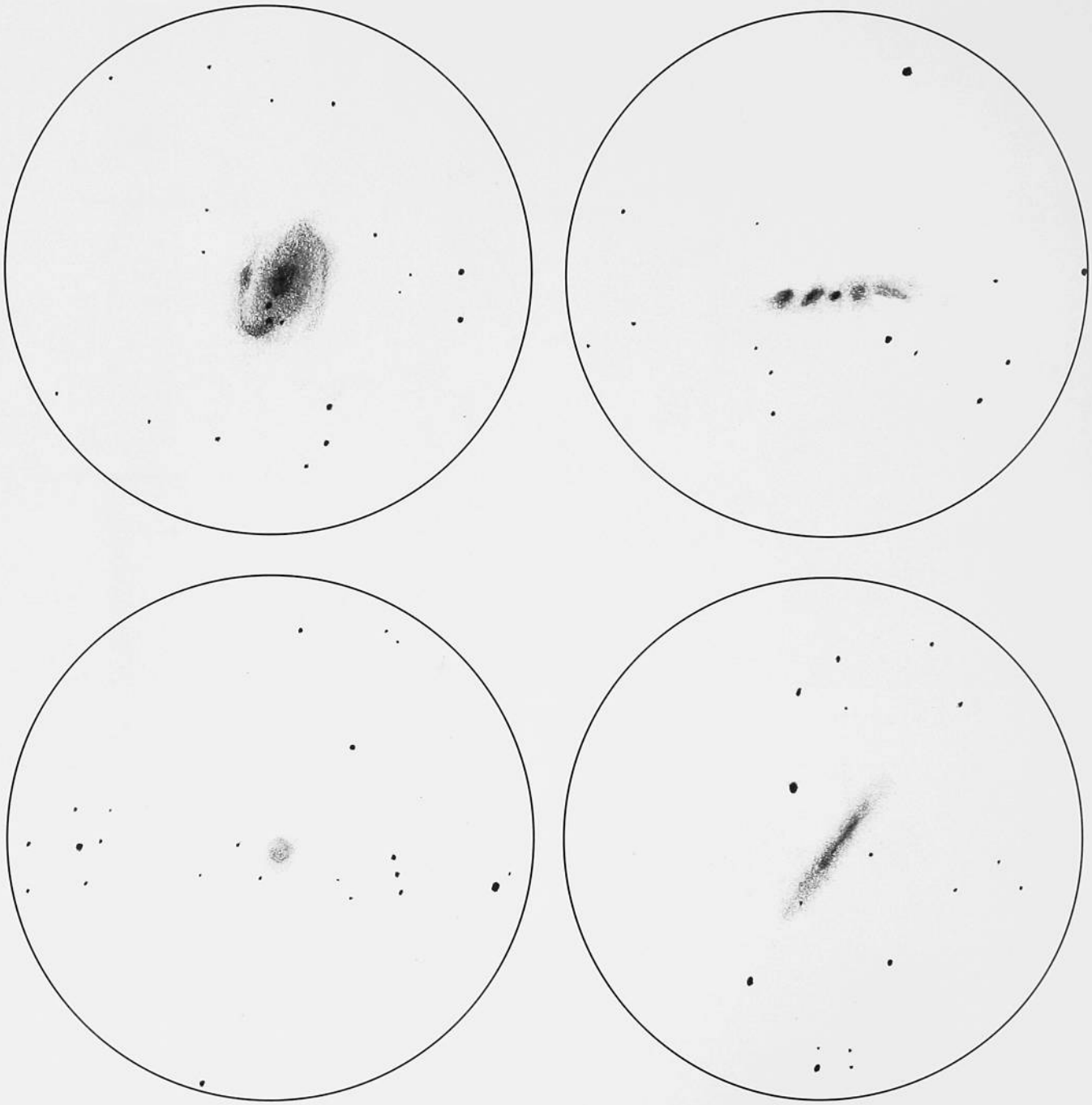
Brian Skiff, working with a 6-inch f/8 refractor from Lowell Observatory's remote Anderson Mesa Site in northern Arizona, saw a very smooth texture to the galaxy at all powers, with no hint of concentric spiral structure. At 195x he saw the brightest region near The center to be nearly circular, 30" across, and with a strong sharp concentration to a completely stellar nucleus.

M82 (NGC 3034) is certainly one of the most-studied irregular galaxies in the heavens. Spectroscopic observations made in the 1960s at many wavelengths led astronomers to the conclusion that M82 is an exploding galaxy. The observations appeared to reveal gas and dust velocities that could only be associated with an explosion. But in the mid-1970s the bottom fell out of the explosion hypothesis with the failure to find a compact center to this explosion and the discovery that the inferred high gas speeds were due to "mirrors" of dust moving past M82 (Solinger, Morrison, & Markert, 1977). It now appears that M82 is a normal galaxy, albeit

Opposite page: M82 photographed by Martin C. Germano (8-inch f/10 SCT, hypered Tech Pan film, 60-minute exposure).

Top: NGC 2403 photographed by Harvey Freed (10-inch f/6 SCT, hypered Tech Pan film, 88-minute exposure).

Right: NGC 2336 photographed by Chuck Vaughn (14-inch SCT at f/7, hypered Tech Pan film, 60-minute exposure).

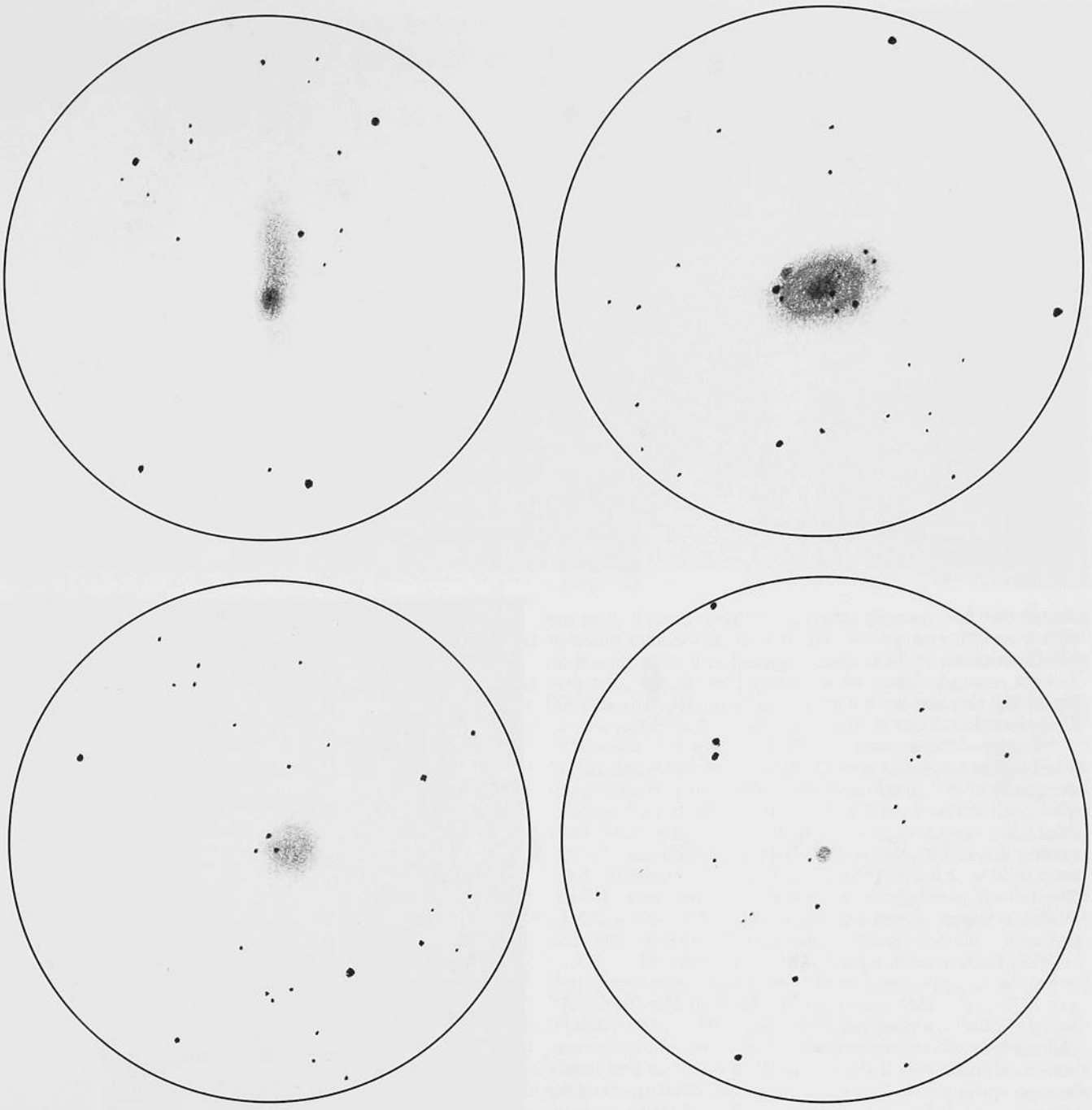


Clockwise, from top left: M81 sketched with a 13-inch f/4.5 reflector at 115x. The field diameter is 42'. The site was Sentinel, Arizona, and the date April 7, 1991. All sketches on this spread are by Tom Polakis.

Top right: The unusual galaxy M82 sketched with a 13-inch f/4.5 reflector at 215x, yielding a 24'-field.

Bottom left: The notoriously faint galaxy Holmberg I sketched with a 13-inch f/4.5 scope at 115x.

Bottom right: The galaxy NGC 4236 sketched with a 13-inch f/4.5 scope at 115x.



Clockwise, from top left: NGC 2366 sketched with a 13-inch f/4.5 scope at 215x.
Top right: NGC 2403 sketched with a 13-inch f/4.5 scope at 215x.
Bottom left: The elusive Holmberg II sketched with a 13-inch f/4.5 scope at 165x, yielding a 30' field.
Bottom right: The extremely challenging galaxy UGC 4459 sketched with a 13-inch f/4.5 scope at 115x.

Galaxies in the M81 Group

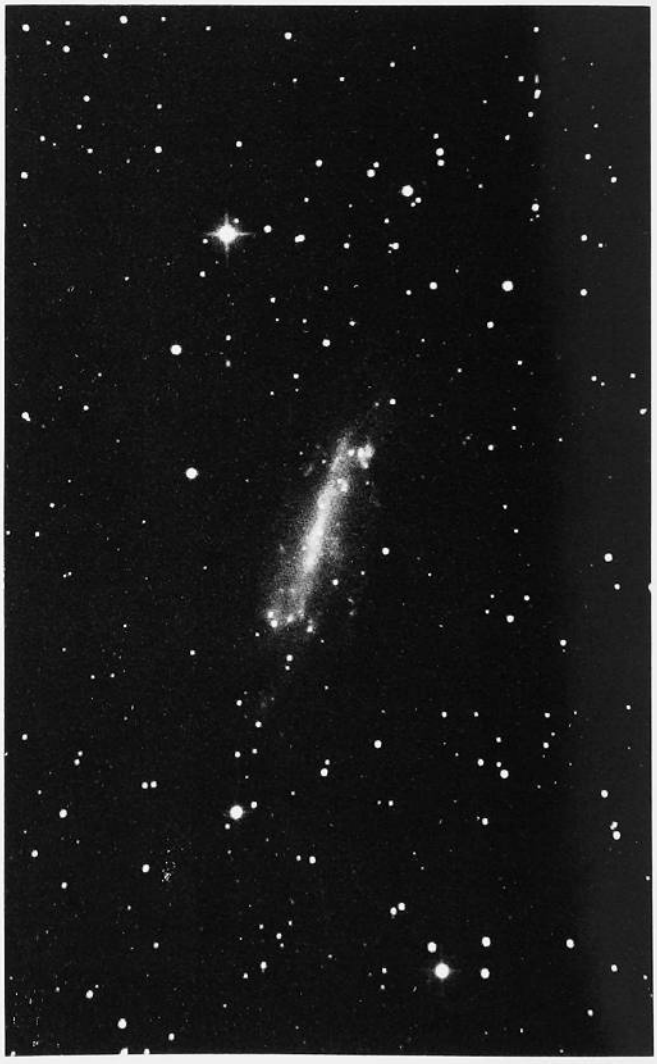
Name	Other	Type	R.A.(2000.0)Dec.	Mag.(V)	SB(V)	Size	Con.
NGC 2366	DDO 42	IB(s)m IV-V	7h28.9m +69°13'	10.9	14.3	8.0' by 3.5'	Cam
NGC 2403		SAB(s)cd	7h36.9m +65°36'	8.4	13.9	23.8' by 12.9'	Cam
Holmberg II	UGC 4305	Im IV-V	8h18.9m +70°43'	10.7	14.8	8.2' by 6.1'	UMa
M81 DW A	0818+71	IBm V	8h23.5m +71°03'	15.9	15.2	1.0' by 0.5'	UMa
UGC 4459	DDO 53	Im V	8h34.1m +66°10'	15.4(B)	16.6(B)	1.9' by 1.6'	UMa
Holmberg I	UGC 5139	IAB(s)m V	9h40.5m +71°11'	12.9	15.3	3.7' by 3.7'	UMa
NGC 2976		SAc pec	9h55.6m +67°55'	10.2	12.7	5.0' by 2.9'	UMa
M81	NGC 3031	SAB(s)ab I-II	9h55.6m +69°04'	6.7	13.1	22.1' by 12.6'	UMa
M82	NGC 3034	I0 sp	9h55.8m +69°41'	8.4	12.5	11.7' by 5.7'	UMa
NGC 3077		I0 pec	10h03.3m +68°44'	9.9	12.7	5.4' by 4.2'	UMa
M81 DW B	UGC 5423	Im IV	10h05.5m +70°22'	15.3(B)	15.8(B)	1.4' by 1.1'	UMa
IC 2574	UGC 5666	SAB(s)m IV-V	10h28.4m +68°25'	10.6	15.0	13.0' by 8.2'	UMa
UGC 6456		Pec	11h28.0m +78°59'	14.7(B)	15.3(B)	1.7' by 1.0'	UMa
NGC 4236		SB(s)dm IV	12h16.7m +69°28'	9.6	14.7	19.6' by 7.6'	Dra
UGC 8201	DDO 165	Im IV-V	13h06.3m +67°42'	14.1(B)	16.2(B)	3.5' by 2.5'	Dra

dusty, that has recently entered the M81 group's thin gas cloud, resulting in intense star formation. Spectra taken of M82's nucleus, in fact, closely resemble that of the Orion Nebula, another center of star formation. It has been proposed that this star-burst nucleus can be modelled as 100,000 Orion nebulae (Jones & Rodriguez-Espinosa, 1984).

Visually, M82 appears quite large: 7' by 1'.5 in p.a. 75°. The brightest region is about 1' in diameter and is just east of the center of the galaxy. High magnifications may be used on this well-defined object. At 165x, this high-surface-brightness object begins to show several prominent lanes cutting through its length at various angles. The nearly central bright spot is almost stellar with a tiny surrounding halo. The fall-off in brightness is very rapid around its periphery. With his 6-inch refractor at 140x, Brian Skiff saw a 2'.5 by 0'.5 core with two clearly visible dark breaks, with the easternmost of the resulting patches being the brightest.

Similar in appearance to the prominent Local Group galaxy M33 is the M81 group's **NGC 2403**. In *The Hubble Atlas of Galaxies*, author Allan Sandage (1961) chose to print photographs of the two side-by-side to point out the resemblance of these two Scd spirals. The content of this nearly face-on spiral galaxy is well documented. Catalogs exist for HII regions (Hodge & Kennicutt, 1985) and stellar associations (Hodge, 1983). Even though NGC 2403 is 3.25 Mpc distant, 19 globular cluster candidates have been detected in it (Battistini et al., 1984), although the brightest has a V magnitude of 17.9 and is out of range for most amateur instruments.

My first impressions of NGC 2403 came through my telescope's 9x60mm finderscope. The similarity with M33 was evident as the view reminded me of, say, a 5x24mm finder view of the Pinwheel. At 165x the 13-inch showed a very bright glow, 8' by 5', in p.a. 120°, with the brightest portion being a 2' diameter region around the center, with no sharp concentration to a nucleus. The spiral structure is discerned as a slightly brighter halo within the glow. I was unable to observe the origin of the ill-defined arms. The most striking feature of NGC 2403 is the presence of a dozen stars of 11th to 15th magnitude superposed over its face, many of these in front of the spiral arms. The brightest star is off the southeast edge of the galaxy. At 310x I tried for some or the stellar as-



NGC 4236 photographed by Martin C. Germano (8-inch f/5 reflector, hypered Tech Pan film, 75-minute exposure).

sociations from the previously mentioned article by Paul Hodge. Surprisingly, eight of these were visible with four associations even showing some size.

Probably few amateurs' lists of showpiece galaxies include **NGC 2366**. But this otherwise ordinary dwarf galaxy contains one of the most interesting HII regions known. The HII region, catalogued as **NGC 2363**, is in the same class of luminosity as such giants as the Tarantula Nebula and Eta Carinae. Most surprising is its presence in such a non-luminous dwarf galaxy. It appears that NGC 2363 is the center of an incredible burst of star formation (Kennicutt, Balick, & Heckman, 1980).

Through the telescope, the galaxy is as interesting as it is astrophysically. In the 13-inch it appears to measure 5' by 1'.5 in p.a. 45° with slight brightening at the southwest end around what initially appears at low powers to be a foreground star. At the northeast end, slightly out of the glow of the galaxy, lies a 13th-magnitude star. Initially ignorant of the HII region, I blinked the galaxy with an O III filter. The effect was stunning! The faint dwarf galaxy disappeared from view, but NGC 2363, the "star" on the southwest end, outshone everything else in the blackened field. A friend's wide-band nebula filter showed the same effect, but not so dramatically, since the emission of NGC 2363 is most intense in the O III lines. Increasing the magnification to 215x revealed a disk about 5" across that brightens substantially at the center.

NGC 2976 is located less than 2° southwest of M81 and is close enough to show effects of interaction with the latter. Radio observations have shown connecting bars of neutral hydrogen to M81's nearby satellite galaxies that are enhancements in the giant HI envelope permeating this entire region (Appleton, Davies, & Stephenson, 1981). Visually, NGC 2976 appears moderately bright, measuring 5' by 2' in p.a. 150°. It is uniform with the exception of a slightly fainter outer halo 1' wide. There is a 13th-magnitude star on the southwest edge. The southeast end of the oval glow seemed more rounded than the northwest end's sharper, more pointed appearance. High magnifications showed a nebulous patch 5" across due east of center at the edge of the haze. At this magnification slight brightening could be seen at the galaxy's center.

East of M81 in the same low-power field lies **NGC 3077**. This small galaxy also requires high magnifications. The 13-inch at 215x revealed a 3' by 2' haze oriented in p.a. 60°, brightening rapidly to the middle. Two 10th-magnitude stars were visible nearby, one 4' northwest and the other 10' west. A stellar nucleus with a bright round core 1' in diameter is centered in the oval glow. With his 6-inch refractor, Brian Skiff saw the core 45" across with a strong broad concentration. The brightest part of the galaxy appeared to be offset to the northwest side.

Observatory photographs of **IC 2574** show a wealth of detail in this irregular galaxy. Some of this detail is visible in small scopes. At 75x with the 13-inch, it appears about 9' by 4' in p.a. 30°, of fairly low surface brightness, and with plenty of foreground stars. A prominent bright region lies at the northeast end, which Brian Skiff observed with his 6-inch scope. This is one of the brightest HII regions in the galaxy, and in the 13-inch at 115x, it is a glow 1' in diameter with some central brightening. A nearly central 2' by 1' condensation in the galaxy's glow can be seen with some difficulty.

NGC 4236 closes out the list of easily observable galaxies in the M81 group. It is 15' by 3' in p.a. 165° and fairly faint. Some brightness variations could be seen across its surface, the brightest of which is a thin 5' by 1' bar displaced toward the north end of the galaxy.

The final seven galaxies featured required much patience to be seen at all. They are interesting mainly because they are dwarf galaxies that can be detected at a great distance. Consulting the *POSS* before and after the observations confirmed what I was really seeing in some of these objects.

Holmberg II is the easiest of these remaining galaxies. It is round, about 5' across, and near an equilateral triangle of 13th- and 14th-magnitude stars. I was unable to pick out any of the HII knots visible on the *POSS*. **Holmberg I** is a very faint dwarf, visible in my telescope only at 115x with averted vision. It appeared less than 1' in diameter and round. On the *POSS* it is elongated 3:2 with its major axis oriented east-west. **M81 DW B** is another challenging galaxy that is less than 1' across on the *POSS*. In the 13-inch at 165x, the galaxy appeared almost 1' across and nearly uniform, except for a 20" diameter knot on the west edge. A magnification of 215x brings this feature out while the rest of the galaxy is not visible. Difficult but not impossible to see is **UGC 8201**. It was best at 115x, showing a 3' by 2' uniform glow elongated east-to-west.

Regarding observations of these final three galaxies, don't try seeing them at home! I could only see **UGC 4459** at 215x as a dull glow, 1' in diameter, with a 14th-magnitude star 1' east. **UGC 6456** appeared through my scope as a 1' diameter haze of extremely low surface brightness, best seen at 165x, while the *POSS* reveals some central brightening and a north-to-south elongation. After three frustrating attempts, I concluded that **M81 DW A** is not visible through my 13-inch telescope. It is in the same low power field as Holmberg II, although the two do not appear to be physically associated (Sargent, Sancisi, & Lo, 1983). In fact, it is practically an averted vision object on the *POSS*! It would be interesting to see if anybody has viewed this galaxy, from perhaps a high altitude site. After viewing these faint dwarfs, it is always fun to go back to something bright like M82 and nearly lose your dark adaptation!

The M81 galaxy group presents a wide range of objects, from the showpieces to the nearly invisible. But with some persistence, you can bring this latter class into visibility. As the group culminates at high altitudes for northern latitudes, it can be viewed through very little atmosphere on crisp winter nights. Test your observing skills on the M81 group on your next observing session.

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***Deep Sky* Reviews**

A Universe of Words

by Mark J. Coco

Photo by Kim Zussman

Messier's Nebulae and Star Clusters, by Kenneth Glyn Jones, (Cambridge University Press, 1991), ISBN 0-521-34028-4, hardcover, 282 pages, $24.95

The Messier catalog is somewhat of an irony. Here we have a list of 100-plus objects that Charles Messier recorded in an effort to prevent confusion with possible new comet discoveries. They were, in a sense, distractions. Today these objects are not distractions, but the center of attention for amateur astronomers, especially those just entering the realm of deep-sky observing. The fact that Messier observed all these objects with a small telescope of reasonable optical quality almost guarantees these same objects will be visible in small telescopes available to today's astronomy enthusiast. And not surprisingly, the Messier catalog has been the subject of many books aimed at this same audience.

Messier's Nebulae and Star Clusters is one such book. This classic work, originally published over 20 years ago, has just been revised and updated. And, of all the books devoted to the Messier objects, this is by far the most extensive. Although the author touts this as a book aimed more at the beginner than at the intermediate or advanced observer, I really wonder since it contains so much information. The sheer size of the book is enough to scare off the newest of stargazers. But what sets this book apart from others devoted to the Messier catalog is the amount of historical information. *Messier's Nebulae and Star Clusters* is chock-full of background information that make this book indispensable as a reference.

The book begins with a lengthy introduction to Messier, his catalog, and how it was compiled. It includes information on Messier's work and that of his contemporaries. The first chapter, strangely enough, deals with the missing Messier objects and the additional objects; that is, those objects listed in the catalog with nothing at the indicated coordinates and those that Messier observed but did not include in his original catalog. While this chapter is very informative, I thought this would have been better placed after the discussion on the catalog, which follows in chapter two. The second chapter is a bit of surprise in that it lists the entire Messier catalog by type (i.e., planetary nebulae, galaxies, star clusters, etc.). This is nice for the beginning observer as it also provides a general overview of the various types of objects in the sky. The third chapter deals with the observing. Topics include telescopes to eyepieces and filters to observing sites.

With the background information out of the way, Jones jumps into the catalog itself which comprises the majority of the book. Listed in order of entry in the Messier catalog, each object is given numerous pages. Each entry begins with technical information such as NGC number, object type, coordinates (which are, unfortunately, in 1950.0 equinox), size, magnitude, and distance. At the end of the book, the author provides a list of all 110 Messier objects in equinox 2000.0, which makes me wonder why he didn't include it with the objects up front.

Following are visual descriptions of the objects made by great observers of the past like Lacallie, Rosse, Webb, d'Arrest, Shapley, and of course, Messier himself. While Jones draws from the observational notes of over 55 different observers, only a few are used for each object. (A biographical sketch of each of these observers follows the catalog.)

Following these "historical" descriptions is technical information about the object. This is more detailed than the introductory technical information and applies more to the physical nature rather than the observational appearance.

After the object descriptions, Jones provides a list of other objects of interest that are close by. This extra added bonus helps to expand his or her obser-

vations beyond the Messier catalog alone.

Each object is accompanied by a minimum of two drawings. The first is usually a wide angle drawing showing the object's position relative to the brightest stars in the constellation. The two exceptions are the Sagittarius and Virgo areas. As many readers know, these two areas contain a disproportionate number of Messier objects. So, instead of repeating the same map for each object, the author put one large one at the back of the book. This was not immediately obvious and a little irritating at first.

The second drawing is a closeup that provides a fairly accurate rendering of the objects as seen through a telescope. Tuto al includes additional drawings, some drawings made by past observers (see list above), are also included. These complement the text nicely and provide the perfect illustration on how visual imaging has improved over the years.

After the detailed catalog a photographic atlas of all Messier objects follows. Most are taken with professional instruments — a bit disappointing considering the book is geared toward amateurs.

While I recommend the book, new observers may be put off by the size and amount of information included within. But they shouldn't be. Everything is written in an easy-to-understand, non-technical style. Furthermore, the book will be of interest to more advanced observers since it contains historical information not found in a single source.

Space Places by Roger Ressmeyer, (Collins Publishers, 1990), ISBN 0-00-215732-2, hardcover, 208 pages, $45.

If you're not familiar with the name Roger Ressmeyer, don't worry, you're not alone. The name was completely foreign to me up until about two years ago when I saw a profile of his photographs featured in *American Photographer*. As I looked over this article, which contained a sampling of his work, I wondered why I had never heard of him before. Night photos of major observatories from around the world indicated he was familiar with astronomy and space sciences. After delving into his new book, *Space Places*, I realized that Ressmeyer's work was familiar to me — it was his name that was not.

Ressmeyer has made a career of photographing leading research centers around the world; space places, as he calls them. Over the years, his photos have appeared in leading magazines like ASTRONOMY, *National Geographic*, *Time*, *Newsweek*, *Air & Space*, and *Discover*. As a working photojournalist, Ressmeyer has access to facilities not open to the vacationing space enthusiast. From the remote Xichang launch complex in China to the weightlessness training pools for Soviet cosmonauts in Moscow, Ressmeyer has been there.

But the many aspects of space exploration are not the sole focus of Ressmeyer's work. Many subjects familiar to the astronomy enthusiast — Mauna Kea, Pic du Midi — have also caught Ressmeyer's eye, often times capturing them from unique perspectives. One unusual portrait popularized by Ressmeyer is the open dome concept in which a time exposure of a telescope is made from outside the dome. As the slit rotates by the camera, the appearance is a dome that opens up 180° to expose fully half of the sky.

Ressmeyer has even turned his cameras on amateur astronomers, documenting their story as well. Dobson, Marling, and Macholz are featured which, although a fair representation of the amateur community, betrays Ressmeyer's home base in the San Francisco area where all these amateurs reside. Ressmeyer could have filled the book with photos that only he has taken. But he resisted the temptation and included many others that document space places to which even he did not, nor could not, have access to. Those photos not taken by the author are clearly labeled and properly credited.

All pictures are briefly summarized with clearly written captions that express the firsthand view of Ressmeyer. With all these beautiful pictures it's easy to lose sight of the author's aim of the publication. Ressmeyer, who grew up in the early days of space exploration, recalls those days with great fondness. And it is the purpose of *Space Places* to bring about a renewed interest among the general public in space, a second space age, if you will. At this the book definitely succeeds.

Although *Space Places* has no major flaws, there are a few photos that raise the question of surrealistic imaging. Ressmeyer boasts in the fact that he didn't use any darkroom work to enhance the appearance of his photos. "None of my pictures are fakes; no darkroom tricks were added later. When the camera's shutter closed, after a fraction of a second or after 10 hours, the image rendered was rendered on film exactly as it appeared through the lens." While this is true (with one exception which Ressmeyer notes in the caption), the book contains some time exposures mixed with fill-flashed foreground subjects. One in particular is Ian Shelton looking through the eyepiece of a telescope while a star-filled sky shines through the slit of the observatory dome. The photo was obviously a time exposure. Shelton was illuminated with a flash sometime during the exposure. While this is not a double exposure or the result of darkroom magic, it looks like one. And, although such photos are indeed aesthetically pleasing, they are somewhat misleading, especially to those unfamiliar with astronomical photography. Don't get me wrong; I don't have a problem with double exposures, fill-flashing or stacking negatives to produce better photos, be they of scientific or aesthetic value; however, I believe the photographer has an obligation to inform the reader. But the captions in *Space Places* are designed to inform the reader about the subject, not about the method used to capture the scene — information more useful to photography buffs.

While the book is aimed at the general public, amateur astronomers will find *Space Places* entertaining and informative. This is the kind of book you should have around when friends and family visit. It will definitely help get them exited about astronomy and space exploration.

Deep-Sky Name Index 2000.0 by Hugh C. Maddocks, (Foxon-Maddox Associates, 1991), ISBN 0-9628305-0-X, paper, 124 pages, $16.95

Here's a quick astronomy trivia quiz. What's the proper name of Omega Herculis? What Constellation contains Plaskett's star? And what is the catalog designation for the open cluster in Carina called the "Southern Pleiades?" In the past, when I had questions like this, I had to dig through mountains of books or call a friend with an encyclopedia-like memory. But not anymore, not since Hugh Maddocks compiled the *Deep-Sky Name Index 2000.0*.

This unique book serves as a quick-reference for thousands of astronomical objects, all within the range of amateur telescopes. The index provides an alphabetical listing of thousands of objects in numerous ways with dozens of cross-references. For instance, constellations are listed by full Latin name, IAU abbreviation, and the mythological figure that represents the group of stars. Stars are listed by proper name, constellation and Bayer designation (if applicable). Therefore, a single star may have as many as three entries.

Deep-sky objects are listed by proper name, Messier catalog number, New General Catalog (NGC) number, and in some cases, by Index Catalog (IC)

Photo by Gary Jones

number. Don't think this book includes the entire NGC and IC catalogs — it doesn't. It contains only the brighter, more commonly observed entries that have proper names. The book does, however, list all Messier objects. For any given entry, the book lists name, object type, constellation, synonyms for the proper name (if there are any) and coordinates in epoch 2000.0. This book makes it so easy to find information that once you start using *Deep-Sky Name Index 2000.0* you'll wonder how you ever got along without it.

By the way, the proper name of Omega Herculis is Cujam, Plaskett's star lies in Monoceros, and the "Southern Pleiades" is IC 2602.

Exposure Guides for the Sun, Moon, and Planets by Ginger LeGendre, (Sky Publishing Corporation, 1991), ISBN 0-933346-61-1, paper, 78 pages, $8.95

You may be wondering why I am reviewing a book about planetary photography for a magazine devoted to deep-sky observing. There are two reasons. First, I've found that many deep-sky photographers also take planetary photos. Second, this book also contains information useful to deep-sky photographers.

Exposure guides are invaluable since they provide recommended exposure times for various f/ratios and film speeds, thus eliminating the need to determine proper exposures by trial and error. All you need to do is calculate your working f/ratio, which the book explains, and you are ready to go. Tables list focal ratios and film speed. Match up the combination you will be shooting with and you are ready to take pictures. The author wisely points out that the recommended exposures should be used as guidelines and not taken as gospel. The book contains exposure guides for the Sun, Moon, eclipses (both solar and lunar) and all the major planets.

Also included is information on photographing comets and asteroids, which although technically considered planetary objects, are photographed like deep- sky objects.

The book does discuss some technique for photography, but the discussions are much too short to be beneficial. *The Exposure Guide for the Sun, Moon, and Planets* contains several illustrations, both line drawings to illustrate the various forms of celestial photography, and photographs to show the reader what can be accomplished. This is a definite improvement over other Sky Publishing books which generally run short on pictures. Other useful information includes a list of angular sizes of all 109 Messier objects and planets. The author also provides a short discussion on how to determine image size on film.

While other books contain the same information (*Astrophotography for the Amateur*, for example) this is the only one devoted strictly to listing exposure information that is also small enough to put in an eyepiece case or camera bag and take into the field. When you consider the price, this book is a great investment.

Challenges of Astronomy by W. Schlosser, T. Schmidt-Kaler, and E. F. Milone, (Springer-Verlag, 1991), ISBN 0-387-97408-3, hardcover, 236 pages, $39.00

In the summer column, I started

something new by reviewing a couple of astronomy lab manuals. I want to continue this practice, at least for a few books, for two reasons. First, there are a few astronomy lab manuals that may be useful to deep sky observers, either experienced or newcomers. Second, most of these lab manuals are titled in such a way that they sound like deep sky observing books. This book, and the one reviewed next, are two examples. (Reviews of these types of books are important for those who purchase books through the mail and do so based on the title.)

Challenges of Astronomy is the latest lab manual I received and it is by far the most technical. The book was originally developed for the German public school system, but its so heavy on math only advanced college students in the United States will not be intimidated by its content. But it's not just the math that will scare off most. A quick glance at the table of contents reveals the true depth of this work. Chapters on laser speckle interferometry and predicting planetary surface temperatures are generally beyond the interest and means of most amateurs. And this is generally the norm for the book as most chapters are quite detailed.

This is not to say that the entire book is beyond the scope of the deep sky observer or photographer -- there are a few of interest to amateur astronomers. Two that I was taken by were the chapters on the atmospheric effects on starlight and another on optical aids and their limitations.

Each chapter is devoted to a single subject and ends with a hands-on exercise.

While there are a few topics of interest to amateurs, most of this book's content is for serious students of astronomy. And at the price Springer-Verlag is charging for *Challenges in Astronomy*, only very serious students need bother purchasing a copy.

Observational Astronomy by D. Scott Birney, (Cambridge University Press, 1991), ISBN 0-521-38199-1, hardcover, 322 pages, $24.95

Like *Challenges in Astronomy* (see previous review), Observational Astronomy is a lab manual designed for college astronomy courses. The books are, however, quite different in intended audiences. *Challenges in Astronomy* is for students interested in pursuing astronomy as a career while *Observational Astronomy* is more of an intermediate astronomy lab manual designed for non-astronomy majors.

The book is logically ordered beginning with the fundamentals of observing and gradually working toward more involved topics. This provides the reader with the knowledge needed for more specialized tasks presented later in the book. It is the earlier chapters that most amateurs will find of interest. Topics covered include the celestial coordinate system, star charts and catalogs, the magnitude system, and visual observations. This last chapter, which is aimed at optics, covers everything from the human eye to eyepieces.

The latter chapters are for those interested in detailed studies. Topics include analysis of high dispersion spectra, classification of stellar spectra and radio astronomy.

The book concludes with several good appendices, which, although not observational in nature, give theoretical information useful to amateurs. One in particular provides a brief, but technically correct explanation of reciprocity failure.

While most of the lab manuals I have reviewed to date are probably not of interest to amateurs, this is one of the exceptions.

Astronomy from A to Z: A Dictionary of Celestial Objects and Ideas by Charles A. Schweighauser, (Illinois Issues, 1991), ISBN 0-9620873-5-1, paper, 186 pages, $14.95

Reference books are an essential tool in the amateur astronomer's library. The ones I turn to first are usually the short dictionary-type which cover hundreds of topics in moderate detail. I use the phrase "dictionary-type" to describe them since the word "dictionary" generally appears in the title. However, these books are more aptly called mini encyclopedias since they cover a broad range of information that generally goes beyond a brief definintion. (Dictionaries generally provide only the briefest of definitions.) The most recent addition to this class of book is *Astronomy from A to Z.*

This new book compares to the *Facts on File Dictionary of Astronomy* in scope, but the latter covers more topics in less detail. *Astronomy from A to Z* is similar in scope, but covers fewer topics in greater detail. While this is a drawback, consider that this book has more illustrations, all of high quality. Arranged in alphabetical order, this book covers dozens of topics in a non-technical language. The text is up-to-date and relects our current understanding of astronomy. What impressed me about this book is that it went beyond the technical descriptions and provided observational information on several objects.

Another welcomed surprise was the use of up-to-date photos. I was shocked to see the picture of Pluto and its moon Charon taken by the Hubble Space Telescope -- an image made only a few months before the book was published. While this is not a book to accompany you to the field, it is a worthwhile reference to keep handy.

Visions of Space, by , (Dragon's World Ltd., 1989), ISBN 0-3817-91896, hardcover, 180 pages, $19.98

In the last column, I tried something different by reviewing *In the Stream of the Stars*, a book on space art. I found it a fun deviation from the books I normally review for this column. Since that last review, I received another book on space art worthy of review. Entitled, *Visions of Space*, this work was actually published prior to *In the Stream of the Stars.*

The books are quite similar in many respects, the primary likeness being they are both packed with drawings and paintings made of real and surreal space scapes. *Visions of Space* is a collection of paintings done by some of today's most prominent space artists.

The paintings are arranged by subject -- space craft, alien landscapes, space stations -- with accompanying text that describes the various works. Biographical sketches of the artists are sprinkled throughout the book to provide a well-rounded treatment.

One encouraging aspect of this is that there are no duplications between this and *In the Stream of the Stars.* However, this book does contain many commonly used space drawings. A quick glance through the pages of *Visions of Space* will show dozens of paintings used in periodicals, journals and books.

As I thumbed through its pages, there was something that bothered me, but I could not put my finger on it. It took one final comparison with In the Stream of the Stars before I realized that the problem lay in the paper used in printing. *In the Stream of the Stars* is printed on a high gloss paper which gives the images a rich, full look. Visions of Space, on the other hand, is printed with a matte finish, robbing the paintings of their luster.

But the paintings are good and well worth a look. If you have never experienced space art, *Visions of Space* is a nice introduction.

Mark J. Coco is an active observer and astrophotographer who works at Celestron International in Torrance, California. His articles have appeared many times in the pages of this magazine.

***Deep Sky* Reports**

A Deep-Sky Survey of Pyxis

by Ernie Ostuno

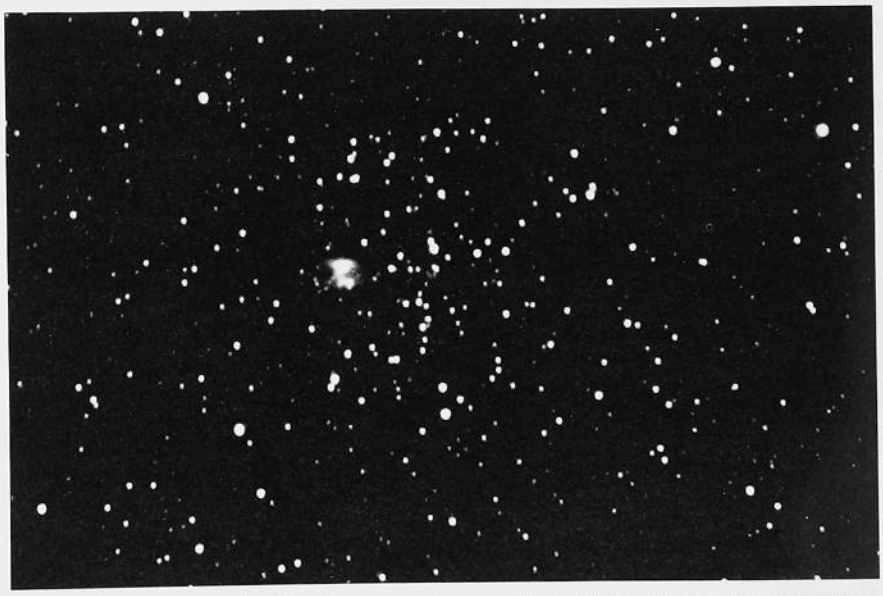
Some constellations, for a variety of reasons, tend to be overlooked by observers. Pyxis, the Mariner's Compass, is such a constellation. It is most prominent in the early evening hours of March, at a time when most Northern Hemisphere observers are still in hibernation. In the Southern Hemisphere, where it is warmer and Pyxis is high overhead, observers find their attention drawn to thestarfields of the Milky Way in nearby Puppis and Vela. Going off the beaten path, you will find yourself rewarded by some find little known objects in this part of th esky.

A good place to begin starhopping from is 3rd-magnitude Beta Pyxidis. Consult chart 363 of *Uranometria 2000.0*. It is a short hop northwest from here to **NGC 2635**, a small group of about 15 faint stars. You'll find high powers advantageous in bringing the members of this cluster out from the sky background. A similar strategy can be used on **NGC 2658**, which can be found just north of Alpha Pyxidis. About 80 stars of magnitude 12 and fainter make up this cluster. A swarm of faint stars surrounds a central knot of three or four brighter stars.

A little over three minutes in R.A. further west and slightly north of NGC 2658 is **PK 254 +5°1**, a small, disk-shaped plantery of high surface brightness. I was pleasantly surprised to find how easy this one was to see. In the 13-inch at 214x it was a small, round, uniformally bright disk. High powers work well on this object. **Collinder 196** and **Collinder 198** can be found about a degree northeast. These appeared as not much more than undistinguished groups of field stars and may well be asterisms. **NGC 2663** is an elliptical galaxy a couple of degrees due south. Northerly observers may have trouble picking htis one out of the horizon haze, but it is fairly bright and should yield itself to high power.

A much more impressive galaxy is **NGC 2613**, which is plotted on chart 321 of *Uranometria*. This bright, elongated spiral is by far the brightest galaxy in its constellation. A rich starfield nicely compliments the sight of this glowing sliver of nebulosity, which is elongated in p.a. 110°. Three degrees further north is **Ruprecht 157**, a group of about thirty stars of magnitude 11 and fainter in an area about 10' across. Scanning southest less than a degree will bring you to **Ruprecht 62**, a smaller cluster composed of similarly faint stars. Continuing in the same direction another two degrees brings you to the field of **PK 244+12°1**. This planetary offers a real challenge to the owners of large scopes. With very dark skies and the right filter, it may be possible to glimpse the two brighter sections of this extremely faint ring-shaped nebula. Another challenging object can be found less than a degree northeast. **MCG-03022-15** is a small edge-on spiral. Using a high power and averted vision, you should be able to glimpse this little spindle. An easier non-NGC galaxy is **MCG-04-21-05**, located southwest of fifth magnitude Eta Pyxidis. This peculiar galaxy was mistakenly classified as a planetary and is included in the PK catalogue. Recent study of this object indicates that it consists of two dwarf galaxies that may be colliding with each other. In the 13-inch at 214x it appeared as a single round patch of uniform brightness. A faint field star is close to the east.

Somewhat fainter, but similar in appearance, is **NGC 2717**, which is plotted on chart 322 of *Uranometria*. This galaxy is on the northern edge of **Sharpless 2-312**, a very faint veil of gaseous nebulosity that covers several square degrees. **NGC 2772** is a small edge-on spiral near the Pyxis-Hydra border. High power once again helps in observing this object, which is elongated in p.a. 71°. **NGC 2821** is yet another small elongated spiral about four degrees southeast. Look for a faint star almost in contact with the northern edge of this galaxy. The lenticular galaxy **NGC 2891** can be found near the junction of the borders of Pyxis, Hydra, and Antlia. Its surface brightness is fairly high and I had difficulty distinguishing it from a faint field star. About three degrees further south is **NGC 2888**, a 12th-magnitude elliptical in a nice star field. Continuing south will bring you to the field of **NGC 2883**. Not having the help of the *POSS* charts, I was unable to positively identify this galaxy. I did suspect seeing it at the position indicated on the finder chart. Perhaps a reader with access to better equipment and/or conditions can confirm or deny this suspected observation.



NGC 2818 photographed by Preston S. Justis (10-inch f/6 reflector, hypersensitized Tech Pan film, 45-minute exposure).

An interesting pair of deep-sky objects rounds out the tour. **NGC 2818** is a cluster of about 40 faint stars and includes a planetary nebula believed to be an actual cluster member. The planetary appears on photographs as a smaller version of M27, but in the eyepiece, all I noted was a circular blob of nebulosity.

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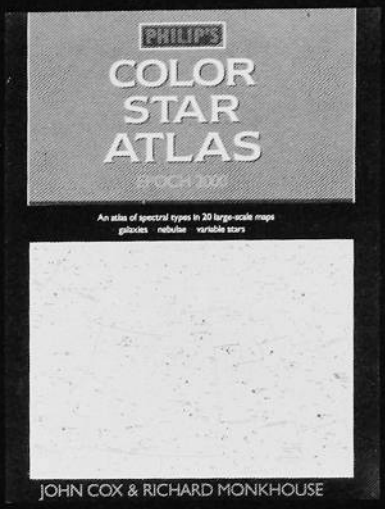

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Deep Sky Reports

Winter's Deep-Sky Challenges

by Phil Harrington

As most of the Northern Hemisphere prepares for the first snow to blanket the land, amateur astronomers ready their equipment to greet the cold, dark nights of winter. Gone are the haze and smog that hang over us during the warmer months. In their place, clear, frigid air lets starlight cascade toward our anxious eyes. Winter is a wonderful season to be an astronomer!

Last winter, I challenged you, the reader, with a set of challenging objects geared for binoculars. Continuing in that great tradition, here is another set of celestial wonders for the binocular user. They are sure to warm the soul of any deep-sky observer on even the coldest nights. Why not try them on for size and let me know how they fit?

Struve 747 (ADS 4182)
Stats: R.A. 5h35.0m, Dec. -06°00' Constellation: Orion Magnitude: 4, 5.7 Separation: 36" Double Star

Struve 764 (ADS 4262): R.A. 5h41.3m, Dec. +29°29' Con.: Aur Mag.: 6.4, 7.2. Sep.: 26" Double Star

20 Geminorum (ADS 5166): R.A. 6h32.3m, Dec. +17°47' Con.: Gem Mag.: 6.3, 6.9 Sep.: 20" Double Star

Here are three double stars suitable to test the resolution of your binoculars and your eyes. Begin at Struve 747 in Orion. Struve 747 lies just southwest of Iota Orionis, the brightest and southernmost star in Orion's sword. Here, you'll find the system's 4.8-magnitude primary paired with the 5.7-magnitude secondary. These spectral-type B1 stars are separated by 6 arcseconds in p.a. 223° and should be split in steadily-mounted 7x glasses.

If Struve 747 posed little trouble, then move along to Struve 764 in Auriga. Struve 764 is found about 3.5° east-northeast of Beta Tauri. Through low-power-glasses, the star will likely appear as a single 6th-magnitude gleam. Giant binoculars should just reveal the system's dual nature. Look for the B star at p.a. 14°, to the primary's's northeast. Both appear snow white, being spectral-type A stars.

The third double star selected for your enjoyment is the magnitude Struve 924, better known as 20 Geminorum. Begin the hunt at 2nd-magnitude

The Horsehead Nebula in Orion. Photo by Geoff Chester.

Gamma Geminorum, which marks the ankle of the twin Pollux. Look about 2° to the northeast of Gamma to find 20 Geminorum, the northernmost member of a right triangle formed by it, Gamma, and another 6th-magnitude star (itself a triple star with 9th- and 11th-magnitude companions).

The stars of 20 Geminorum are separated by 20", very close by binocular standards. As a result, resolution is unlikely in less than 20x glasses. Still, given steady seeing, the 7th-magnitude secondary should be visible to the primary's southwest at p.a. 210°.

Give these three test stars a try and let me know your results. Please include details about your binoculars and observing conditions.

Collinder 62

Stats: R.A. 5h22.5m, Dec. +41°00' Con.: Aur Mag.: 4.2p Size: 28' Open Cluster

Have you ever seen Collinder 62? Probably not, but if you own a pair of 7x binoculars, it awaits your visit. Collinder 62 is located about 5° south of brilliant Capella in a star-rich region of the Milky Way. Through most glasses, it appears as a small company of faint stars punctuated by a lone beacon. It is this latter star that artificially boosts the cluster's overall magnitude to 4.2. Though this number is a bit misleading, the cluster is still enticing enough to warrant a visit on the next clear night. Incidentally, the brightest cluster member also forms an attractive four-star diamond asterism that includes Rho and Lambda Aurigae.

IC 434 and Barnard 33

IC 434: R.A. 5h41.0m, Dec. -02°24' Con.: Orion Mag.: -- Size: 60' by 10' Emission nebula

B33: R.A. 5h40.9m, Dec. -02°28' Con.: Orion Mag.: -- Size: 6' by 4' Dark nebula

On page 64 of my book *Touring the Universe Through Binoculars* (John Wiley and Sons; 1990), I state that the best known example of a dark nebula is the Horsehead Nebula in Orion, although it is too small and faint to be visible in binoculars. Until last February, I considered this to be a correct statement. But after spending some time observing alongside Tom Lorenzin (author of *1000+: The Amateur Astronomer's Field Guide to Deep Sky Observing*) at the Winter Star Party, I have to admit that it is only half right.

The Horsehead remains the best known dark nebula, but Tom showed me that it is indeed visible in giant binoculars. With a pair of nebula filters precariously mounted (Scotch-taped) to the eyepieces of 10x70 glasses, we each saw both the emission nebula IC 434 and, more amazingly, Barnard 33. The Horsehead was small, looking like a thumb viewed from a few dozen feet away, but it was unmistakable. Wow!

To find this challenging couple, aim your filtered binoculars so that Zeta Orionis, the easternmost star in the Hunter's belt, lies near the top of the field of view (north) and nearby Sigma Orionis is positioned toward the right (west). Look near the center for a pair of 8th- and 9th-magnitude stars. These mark the leading edge of IC 434 and are just west of the Horsehead. Using averted vision, carefully scan for the sharp eastern boundary of IC 434. Once spotted, search just east of those two faint stars for the Horsehead itself. With Tom's help, it took me only a few minutes to pick out both objects. Of course, the crystalline skies of the Florida Keys sure did help.

NGC 2403

Stats: R.A. 7h36.9m, Dec. +65°36' Con.: Cam Mag.: 8 Size: 8' by 11' Galaxy

Hovering above the northeastern horizon at this time of year is the obscure constellation Camelopardalis the Giraffe. Though the human eye alone reveals little more than a void populated by 4th-magnitude and fainter stars, binoculars begin to unleash some of its latent wonders. For this installment, I chose NGC 2403 as a suitable assignment for observers with binoculars. Begin your quest for NGC 2403 at Omicron Ursae Majoris, the nose of the Great Bear. Once there, slip about 5° west to 6th-magnitude 51 Camelopardalis. NGC 2403 is found about a degree farther west.

NGC 2403 is one of the brightest galaxies in the northern celestial hemisphere that was missed by Messier and Mechain. Perhaps this was due to its sparse surroundings. Today we know that even 7x glasses reveal this Sc spiral as a dim, oval patch of grey light set among a field of 7th-and 8th-magnitude suns. Moving up to 11x80 glasses causes both the galactic core and the surrounding spiral halo to increase in apparent size and intensity.

Though invisible in binoculars, great detail in NGC 2403 can be glimpsed when viewed through moderate-size amateur telescopes. A 10-inch instrument hints of spiral arm structure toward the galaxy's western edge, a trait more readily confirmed in 12-inch and larger telescopes. These same scopes also reveal a very faint nebulous "star" within one of the spiral arms. Higher power confirms that this is not a star at all, but rather a huge HII region separately cataloged as NGC 2404.

Galaxy NGC 2403 photographed by Tom Eby (8-inch f/10 SCT, hypersensitized Tech Pan film, 43-minute exposure).

***Deep Sky* Reports**

Success with S147!

by Alister Ling

No, not the whole thing, just a piece. And there's more yet to be seen! Simeis 147, a large supernova remnant in Taurus, will always hold a special place for me in my *Uranometria 2000.0*. I can open the atlas to chart 136 with my eyes closed. There, Nature has left her stamp — a coarse, wavy page after the night's dew has evaporated.

S147 was discovered in 1952 at the Crimean Astrophysical Observatory, located at Simeis, in the U.S.S.R. by Shajn and Hase. The supernova remnant was also found on the *Palomar Observatory Sky Survey* (*POSS*) prints at roughly the same time. More recently, this delicate web of nebulosity has come to be known as Sharpless 2-240.

A special deep red Palomar Schmidt plate (reproduced in Neckel and Vehrenberg's *Atlas of Galactic Nebulae*) reveals a roughly circular ring some 3° in diameter, consisting of crisscrossing filaments, some very faint, others brighter. Reminiscent of the Gum Nebula in Vela, S147 can also be compared to the Veil Nebula. The Cygnus Loop's other name, the Network Nebula, brings some finely-detailed images to mind. One might think of S147's filaments as fainter cousins to the ones inside each arc of the Veil. Strange as it may seem, the negative photo from the Neckel-Vehrenberg *Atlas* is actually overexposed from the visual observer's perspective.

Many amateurs find S147 an appealing object. Like all the famous deep-sky challenges, it has a certain mystical attraction. Possibly the greatest lure of exotic deep-sky objects is the promise of the observer reaching a "peak experience" when he or she finally detects that elusive target. It's also neat to be among the first humans on this planet to see these rare objects with one's own eyes. It's a wonderful feeling.

The history of amateur astronomy shows us that as every year goes by, so-called "impossible" galaxies or nebulae fall prey to the eye of patient observers. They wait for that uncommonly dark and transparent sky to bring out a list of elusive targets and go for the gold. With S147 it was no different, just a matter of time. As telescopes continue to get bigger, new challenges will have to be dreamt up.

More than aperture however, the O III nebula filter has relegated many challenge objects to the "easy" class. Legion are the barely visible blobs in a 17.5-inch scope which turn into detailed interestiny swaths in an 8- or 10-incher armed with an O III. I had a feeling that an arc or two of S147 might be observable through a well baffled 12.5-inch Newtonian, because contrast in deep-sky observing is often more important than raw aperture. It barely turned out to be true.

I'm the first to admit that it is easier to find an object once you know where to look, rather than to randomly sweep

Central S147 photographed by Martin C. Germano (8-inch f/5 reflector, hypersensitized Tech Pan film, 90-minute exposure).

about in a vain search. However, I didn't know the exact location, nor what to expect. The Neckel-Vehrenberg photo I had was so overexposed, I couldn't tell the relative brightnesses of the nebulous arcs. My only option was to indicate the ten brightest sections on my *Uranometria* and then go out and see what I could find.

As luck would have it, I started at the wrong end of the nebular complex, in the south, then slowly star hopped my way to the north side. Throughout the sixty to ninety minute search I faithfully used a dark hood to cut out stray light (even in dark skies, why take the risk?) and kept my observing eye closed while reading the star atlas.

I was begining to tire when I decided "one more arc, then I'll quit." And suddenly there it was! What a relief — I could then let my fatigue well up inside me. With a contented gaze upwards scouting for Leonid meteors, I got my observing buddy Jerry Spevak to confirm the small streak of nebulosity that I nabbed. All that I managed to see was a small blob elongated about 1:4 in a north-south orientation, attached to a 10th-magnitude star. I was sure it was not symmetrical about the star, and brighter stars did not have a similar blob. It could only be a piece of S147. But it sure wasn't obvious!

As happy as I was, I wanted to be certain of my sighting could I trust my eye? At home, in a well lit-room, I could only be disappointed that the Neckel-Vehrenberg *Atlas* did nothing to confirm my sighting. The 10th-magnitude star that I saw touching the nebula was nowhere to be seen, lost under this huge tangled mess of black filaments. I went to the University of Toronto to check the *POSS* prints, since these were not really deep exposures. The thrill really hit me when I saw the *POSS* print of S147 — there was the star and the nebula — dead on!

The blue *POSS* print (at arm's length) reveals only three sections of the entire S147 complex. The piece I saw was the brighter of the two. I have found that for visual observation of emission nebulae, the nebulosity on the blue plate is more representative than that on the red. Encouragingly, there are appear two more streaks of nebula visible on the blue print that are almost as bright. One of the sections splits off to the southeast from the north-south bit. The other is pointed out on the *Uranometria* chart.

Join the expedition to discover other nebulous arcs this winter. Why not strive for one of these Holy Grails of visual deep-sky observing? There are many big scopes out there — just wait for that great night, use a hood, an O III filter, and most of all, be patient and appreciative. The emotion is great.

Simeis 147 is one of the grandest cosmic bubbles in the sky. Photo by Bernd Koch and J. Stahlhut (10-inch f/1.7 Schmidt camera, hypersensitized Tech Pan film).

Small Scope Showcase

A Night of Reflection

by Alister Ling

Wide-field observing with an f/10 SCT?! Doesn't sound possible, does it? But with the appropriate accessories, a surprising new universe becomes accessible to the owner of this popular instrument. Milky Way fields are richer than ever, large nebulae and open clusters are beautifully framed, and unusual objects can be detected.

Today, there are two ways to make your f/10 into a rich field telescope. The latest is to use the new f/6.3 focal reducer from Celestron. A 32mm eyepiece used to give a moderate exit pupil of 3.2mm, can now deliver a much wider 5.1mm pupil with the reducer. Another method is to purchase a 2-inch star diagonal and 56mm Plossl eyepiece. This combination produces a 5.6mm exit pupil without the added lens elements of a corrector.

My observing buddy Jerry Spevak chose the latter route while "reducing" the overall cost by trading in all his regular eyepieces and 1.25-inch star diagonal. Eager to try out the "new" 8-inch scope, we headed out to our dark site.

Our first target was one of winter's finest. I'd almost forgotten how beautiful the Pleiades are in their entirety. My own small scope is a 5-inch off-axis aperture on my 12.5-incher, yielding an effective f/14 relatively narrow field instrument. A wide field is the only way to observe this spectacular open cluster. To truly appreciate its beauty is to see it in its setting, surrounded by some dark space, as diamonds on black velvet, to use a familiar expression.

With such a large field and dark skies, the Merope Nebula glowed within easy reach. I had never seen it so starkly before. This wispy reflection nebula was brighter than the light scatter surrounding all the bright stars. The encroaching dew was beginning to give each star a small round "reflection nebula," but Merope's glow was much bigger and headed southward off to the edge of the field. In my enthusuasm I have to remember that this nebula can't be too easy, otherwise it would have been noticed by the keen eyes of William and John Herschel.

Flushed with this success we headed over to M78, one of the brightest reflection nebulae in the winter sky. Forming a vertex of an isosceles right-angled triangle with Orion's belt stars, **M78** (NGC 2068) can be located without

Emission nebula M78 photographed by Kim Zussman (modified 11-inch f/10 SCT, hypersensitized Tech Pan film, 90-minute exposure).

IC 405, the Flaming Star Nebula, photographed by Martin C. Germano (8-inch f/5 reflector, hypersensitized Tech Pan film, 45-minute exposure).

problem. Instead of its usual crisp northern border our eyes were met with a washed-out blob — the corrector plate had dewed up. After applying a good dose of heat to clear away the condensation the sky was black once more and M78 stood out in sharp relief. The nebula was so bright we had to search for the two embedded stars.

Again we were impressed by the darkness of the night since the companion nebulosity **NGC 2071** was visible. This much smaller and fainter blob lies in the same field to the northeast. We found its edges to be quite undefined, so we switched to higher magnification, the only way to see good detail in the smaller deep-sky objects. Strangely enough, we ran out of focusing room on the SCT with a couple of millimeters to go! Our 2-inch to 1.25 adapter was too thick, which forced us to stay at low power the entire night. The two much fainter wisps of nebulosity closer to M78 were not visible. Sometimes you just have to use aperture.

Since we had no choice but to use 35 power and no filters, we decided to stay with large reflection nebulae, to make best use of the dark and transparent sky. With Auriga no longer close to the horizon we paid some short visits to the Messier clusters on our route to the **Flaming Star Nebula**. On *Sky Atlas 2000.0* this part emission part reflection nebula is labeled IC 405. Even with the illuminating bright star AE Aurigae in sight, a large area of faint nebulosity could be seen extending to its north for almost half a field of view. It was a pity we weren't able to try out any filters on this fascinating object, because I've heard that an H-Beta helps the contrast somewhat. Photographs show a bright streak of emission nebulosity about 20' north of AE — something you may want to attempt one night. The long western "tail" of the nebula plotted on *Uranometira 2000.0* was nowhere to be seen.

By the time we decided to go for the **Cone Nebula** (NGC 2264), and swung the scope around, the corrector plate had gathered frost in the crisp night air. Each occasion this happened we lost about 15 minutes of scope time, but we did enjoy the rare spectacle of a bright winter Milky Way coursing through Monoceros and Puppis while the hot-air blower did its job.

Easily visible in the finder scope is NGC 2264, better known as the Christmas Tree cluster. This small bright clump in Monoceros takes on a classic tree shape with low power, and is magnificent in a wide field. Even at 35x, several pairs of stars were recognizable. If you enjoy observing open clusters but haven't done much double-star work, NGC 2264 is a nice place to start. Most optical pairs here are 15 arcseconds or more apart. *Sky Catalogue 2000.0* lists eight pairs associated with the brightest star, S Monocerotis. With the 8-inch SCT we were able to see all but the closest one, at p.a. 213° and 2.8" separation. There are two other easy Struve pairs, one at the "top" of the Christmas tree, and the second on the west "corner." With higher power more pairs become accesible to the dilligent observer.

Our biggest surprise of the night was that nebulosity was readily noticeable in a squashed box of stars at the western corner of the tree. It was not involved with the bright star S Mon at the base of the tree. The nebula completely surrounded the eastern two stars of the quadrilateral and proceeded about two-thirds of the way to the western two.

This observation amazed us because on several occasions in the past I had failed to find even a hint of the nebula with my 12.5-inch scope under decent skies. More nails hit the coffins of two myths: one, an SCT is not a deep-sky instrument because of its long focal ratio, and two, aperture is all important. As we confirmed, a truly dark sky and clean optics are the two most important factors for detecting reflection nebulae.

For a change of pace we decided to observe some winter galaxies. **M74** (NGC 678) was invisible until the corrector plate was yet again defrosted. Then we saw a small, round bright disk in a faint halo. There was some tantalizing detail visible but it had to remain that way since higher power eyepieces could not reach focus. Frustrating!

To close the night with a satisfied mood all we had to do was stare at **M42** (NGC 1976) for a few minutes. There's nothing quite like detecting ghostly wisps of gauzy light for hours, only to receive a full impact from an outstanding nebula. Get out there this winter and see for yourself. You'll never regret the experience.

Double Stars

Beneath the Seat of Cassiopeia

by Paul Brown

Cassiopiea is my favorite autumn constellation even though it shines brightest in the winter. That oddly shapped "W" rising over the treetops acts like a great counterbalance to the southern end of the Milky Way. But long after the summer splendor has left the sky, Cassiopiea remains. It is nearly circumpolar from my mid-latitude position, which means I can start my observing here in early fall, but the best views come under crisp winter skies. Even though the nights may be cold they are longer too, giving the amateur who works for a living a greater chance to enjoy the breathtaking beauty of the clusters, nebulae, and double stars that abound here.

This winter's selection of pairs lies south of the brightest stars that form the familiar seat-shaped asterism of Cassiopeia. Most amateurs liken it to the letter "W" that, eventually as the winter progresses, becomes an "M." If you follow along some evening, testing your eye and telescope, perhaps noting your results, you can't help but discover some magnificent deep-sky objects. The sky will not let you observe one particular type of target for long.

The first pair, **Lambda Cassiopeiae** (ADS 434), is one of the more difficult objects described here. If you choose, return to it once your eye becomes accustomed to small separations. Even though it is a scant half-arcsecond apart, the components are nearly equal, 5th-magnitude stars. My 10-inch f/5.5 at 300x will elongate the Airy disks, creating a perceptibly oval shape if the air is rock-steady with little to no undulation in the image. A magnification of 700x resolves the pair into a figure 8-shape of two disks barely overlapping. Because I use this pair as a seeing test often, its dual nature is evident even during less than average seeing.

Lambda's binary nature is well catalogued in professional literature; but, the results of the observations are mixed. Charles Worley in 1986.9 put it at 0".55 in position angle 187°. W.D. Heintz had nearly the sam efigures of 1988. Of some interest however, are the speckle measurements of Harold McAlister wherein he lists the separation as 0".457. Based on my success with 8- and 10-inch apertures, I tend to side iwth Worley and Heintz, but how interesting it would be to hear from others regarding their results.

Double Stars in Cassiopeia

ADS	Other	R.A.(2000.0)Dec.	Mags.	Sep.	P.A.
434	OΣ12	0h31.8m +54°31'	5.5, 5.8	0.46"	187° (1985)
501	A913	0h36.4m +56°21'	9.4, 9.8	0.7"	93° (1981)
504	A914	0h36.6m +56°08'	8.4, 8.9	0.4"	32° (1981)
561	Alpha	0h40.5m +56°32'	2.2, 8.9	69.6"	282° (2000)
630	Arg. 2	0h45.8m +54°59'	8.4, 9.4	2.5"	73° (2000)
			12.8	12.8"	90° (1928)
659	Σ59	0h48.0m +51°27'	7.2, 8.1	2.2"	147° (1974)
671	Σ60	0h49.1m +57°49'	3.4, 7.5	12.0"	307° (1980)
719	Bu 1	0h52.8m +56°38'	7.8, 9.8	1.4"	82° (1936)
			8.8	3.8"	133° (1936)
735	Σ70	0h53.8m +52°41'	6.3, 9.3	8.0"	245° (1962)
1105	Σ115	1h23.4m +58°09'	7.1, 7.3	0.26"	135° (1981)

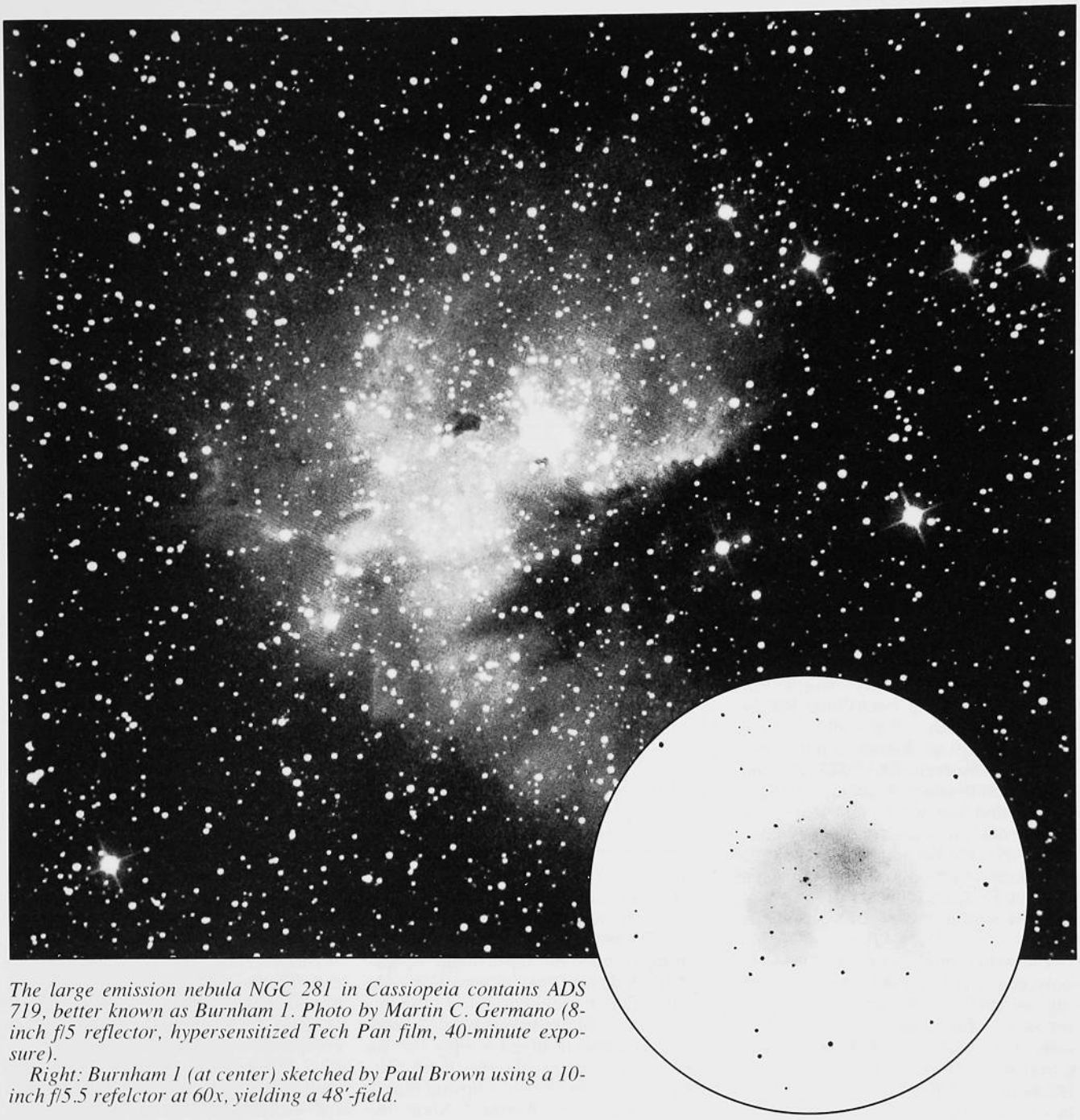
A much easier pair is **Alpha Cassiopeiae** (ADS 561), the brightest star in the constellation. It is worthy of your interest if only for its color, a rich deep orange. William Herschel first catalogued the magnitude 8.9 companion at roughly one arcminute distance in 1781. Today, it is still an easy target for small apertures and can be used as a guide for estimating smaller separations. My own interest in this wide optical pair is a marker to two Aiken pairs close to the west: **A913** and **A914**, both plotted in *Uranometria 2000.0*. Both are exceedingly difficult, but for different reasons. A913, the fainter of the two has a wider separation that I strongly suspected and my estimate of position angle placed the pair due east-west (not far from the catalogue value). As for A914, I cannot be sure. My position angle guess here was reasonably close, but both these pairs are better suited for 12- to 16-inch telescopes.

About one and a half degrees southeast lies the itny but delicately beautiful **ADS 630** (Argelander 2). I chose to included this pair for the simple enjoyment it will provide the determined observer. Using a wide-angle eyepiece, the field surrounding is Milky Way wonderful. The same 60x in a 10-inch will also barely resolve the closer and bright of the two companions lined up on one side of the primary. Not until the Moon left the sky did I find the fainter more distant sun. An experiment with a 4-inch, off-axis mask proved successful with the B component yielding at 300x. The C star proved marginal evenusing averted vision.

ADS 671 (Struve 60) is a stunningly beautiful binary located one-third of the way along a line between Alpha and Gamma. Admiral Smyth called it a "superb physical object" using a 6-inch refractor. I would add that it is suitable for all apertures but keep the magnification low. With the components shining at magnitudes 3.4 and 7.5 some 12 arcseconds apart, there is no challenge here for the telescope, only the enjoyment of guessing the colors involved. The spectral types G0 and M0 imply yellow and orange-red to which Smyth and Webb agree. I got pale yellow to white for the primary and aqua for the fainter star. If you were limited to one observation of double stars in Cassiopiea, this pair would be a good choice.

A full finder scope field to the east lies **ADS 1105** (Struve 115). It should be easily swept up at binocular power as its position is well marked being close southeast of Phi and its attendant open cluster, NGC 457. I draw your attention to it for what it is not!

The fact that Struve listed it means it should be visible in a 10-inch, especial-



The large emission nebula NGC 281 in Cassiopeia contains ADS 719, better known as Burnham 1. Photo by Martin C. Germano (8-inch f/5 reflector, hypersensitized Tech Pan film, 40-minute exposure).

Right: Burnham 1 (at center) sketched by Paul Brown using a 10-inch f/5.5 refelctor at 60x, yielding a 48′-field.

ly as its components are near-equal 7th- magnitude stars. In addition, *SkyCat* puts it 0".7 apart for 1959. These data indicate a relatively easy split at 300x. Several attempts up to 700x produced negative results, except for one observation in the late 1980s using an 8-inch f/7 scope that yielded a position angle of 160° and a Δm (magnitude difference) of 0.5. Not until reading a USNO publication by Charles Worley did I realize the reason for the odd result: the separation is a meagre 0".26 (1981). Harold McAlister's speckle measurement for 1988 is even less! Such a close pair is beyond even e recognition level of Airy disks in a 10-inch. Obviously my results using an 8-inch scope were spurious.

An example of a multiple star buried in an emission nebula, my favorite type of deep-sky object, is **ADS 719** (Burnham 1) lying one wide field south of Eta. Using a sweeping power of 60x in the 10-inch, the approach to the multiple brings NGC 281, the nebula, into view. Even in an 8-inch the area is obviously hazy or as some would say, less dark than the surrounding field. The use of an O III filter and a 16-inch aperture on this nebula produces amazing results.

The accompanying sketch attempts to show how the nebula curls aroudn Beta[1] Cassiopeiae. Unfortunately higher powers are needed to separate some of the fainter and closer components of the multiple but all should be visible in a 4-inch using 100x. Without consulting references, I tried to resolved the members using a 10-inch but missed consistently the B companion at 1".4. This might be attributed to the presence turbulent seeing. Once the multiple climbed out of the horizon's murk however each component yielded easily appearing, as a group, like tiny gems embedded in a pearlescent haze.

Variable Stars

Let's Have Some Action!

by Paul L. Sventek and Tom Arnold

Amateur astronomers like to see "action" in the sky. This helps explain the popularity of observing solar and lunar eclipses, lunar grazes and occultations, meteors, and, of course, variable stars.

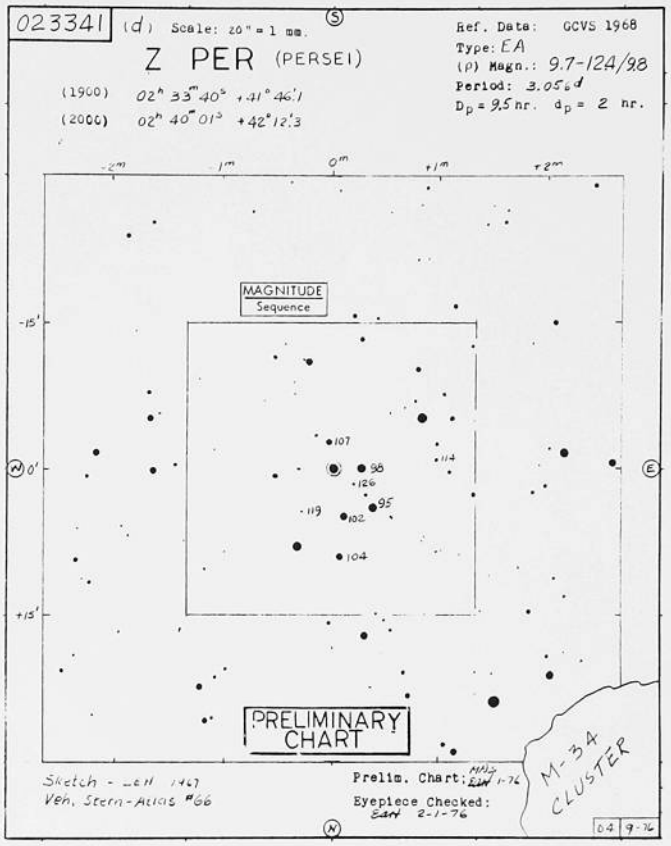
Numerous kinds of variable stars have been discussed in this column, but there are a few types that receive little attention yet provide the amateur the opportunity to provide meaningful data on infrequently observed stars. Carefully recorded and submitted data on these special stars frequently provide the astronomical community with the only information on the stars' behavior. Because their work is unique, diligent observers have their observations published in various amateur and professional journals.

What kind of variable stars provide this opportunity to turn your hobby into something scientifically worthwhile? Consider eclipsing binary and RR Lyrae variable stars.

The American Association of Variable Star Observers (AAVSO) currently has a membership of about 1,200 people around the world. Of these, only twelve observers are consistently active is the AAVSO's eclipsing binary and RR Lyrae observing groups. The leader of both groups for the last 23 years has been Marvin Baldwin of Butlerville, Indiana.

Baldwin's interest in amateur astronomy began back in the mid-1950s during an Air Force assignment in Germany at a remote radar site. The nights were long and very dark deep in the German countryside; to pass the time, Baldwin used the radar site's binoculars to scan the sky. Trips to Baldwin's support base library provided him the books and magazines he read to learn about what he was observing. By pure chance, he read about variable stars, and he quickly discovered he could not only identify the brighter eclipsing variable stars Algol and Delta Librae, he could easily notice when they went into eclipse.

Baldwin wanted to be able to measure the progress of these eclipses, and one method he learned early on was to pick comparison stars whose brightness were within the minimum and maximum values of the particular eclipser he was interested in. One night he was watching a star field he had defined before, but one of the stars he had been using as a (constant) comparison star had significantly changed in brightness. He began watching this particular star as well, and after several months, he had determined an approximate eclipsing period for this strange star. He wrote a letter providing these observations to an address in one of his library references and received a reply that he had independently observed and confirmed the period of an eclipsing binary star called WW Aurigae. Soon the AAVSO was after Baldwin, once they learned what he was doing with just a simple pair of binoculars.



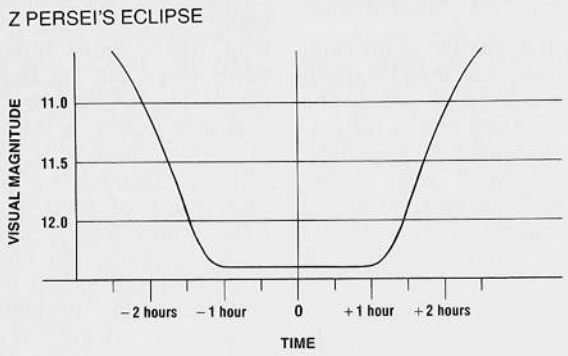
Baldwin currently uses a 10-inch Newtonian telescope to make his observations from his farm in southern Indiana. Using only this telescope, he can comfortably keep track of about six eclipsing or RR Lyrae stars at a time. The record for simultaneous eclipsing binary observations, however, must go to Greenfield, Wisconsin, amateur, Gerry Samolyk. Using the eight 10-inch Newtonian telescopes (and sometimes adding two 12-inch Newtonians as well) of the Milwaukee Astronomical Society arranged in a circle at their observatory site, Samolyk places one target star in each telescope and walks round-and-round his telescope circle observing and recording non-stop for hours at a time.

Baldwin and Samolyk are tops in their observing field. The data they and the other AAVSOers provide eventually finds its way into well worn Apple computers owned by Baldwin and Samolyk. They reduce the observations and maintain a database of minima times for eclipsing binaries and maxima times of RR Lyrae stars and make this information available to the AAVSO.

The AAVSO has a set of eclipsing binary and RR Lyrae "program" stars which are carefully monitored by interested observers. Baldwin and Samolyk have an "unofficial" list of stars they go after as well. In addition, Baldwin scans an annual Polish publication (*Eclipsing Binary Ephemeris*, Rocznik) or the Russian *General Catalog of Variable Stars* for stars with no published minima in recent years (or maxima, in the case of RR Lyrae stars, also covered in the publications). He then checks his own library or the Indiana University Library for references mentioned in *Rocznik* or the *GCVS* for

When to begin observing Z Persei's eclipse

Julian Date	Calendar Date (Univ.)	Universal Time
2448614.55	12/24/1991	01h 10m
2448617.61	12/27/1991	02h 40m
2448620.66	12/30/1991	03h 50m
2448623.72	1/ 2/1992	05h 20m
2448626.78	1/ 5/1992	06h 40m
2448663.45	2/10/1992	22h 50m
2448666.51	2/14/1992	00h 10m
2448669.56	2/17/1992	01h 30m
2448672.62	2/20/1992	02h 50m
2448675.68	2/23/1992	04h 20m
2448678.73	2/26/1992	05h 30m
2448681.79	2/29/1992	07h 00m



The composite lightcurve shown above for Z Persei is generalized from observations made by five different AAVSO observers. Your observations will likely not fit exactly on this lightcurve, but they should show the same general shape. The eclipse predictions in the table correspond to the extreme upper left-hand portion of the lightcurve. This is the time to begin observing!

charts or other ways to identify these stars which are sometimes called "orphans." If no chart exists, Baldwin resorts to the method he first used in Germany of drawing the area around the target star location and waiting, watching, several times a night, every night, until something happens. With the target identified, he then begins observing to establish or confirm a period.

Although the variability mechanism for eclipsing binary stars and RR Lyrae stars is very different, the observing method for each type isn't. Eclipsing binaries vary because one member eclipses the other thus causing the light output of the entire star system to decrease at regular intervals. RR Lyrae stars, on the other hand, actually pulsate, causing their changes in brightness. The so-called Blazhko effect causes light curve shape changes in some RR Lyrae stars, making them particularly interesting to watch over time. In general, both types of variables can be observed in an evening by making observations at specific periods of time. The trick to observing these stars is to know beforehand when an eclipse is to occur (EB stars) or when a maximum is to occur (RR stars). The AAVSO EB and RR program stars have well established periods, and annual predictions are made available to all interested observers so they can plan observing sessions to be assured of successful observing runs. Observers use special AAVSO charts to observe these stars one of which is reproduced here for the eclipsing binary star Z Persei.

The purpose behind observing eclipsing binary stars is to determine the time of mid-eclipse; the allure for observing eclipsing binary stars revolves around the fact that the period between eclipses for some eclipsing binaries drift or abruptly change. Observations of these stars are needed to record their behavior over long periods of time so theories can be made to explain why these period changes occur.

The chart for Z Persei provides all the necessary information to go about making observations of its eclipse. Z Persei is located very near the open star cluster M34 so should be quite easy to locate, and during late December 1991 and first two months of 1992, Z Per makes a dozen conveniently timed eclipses visible from North America (observers elsewhere can note that Z Per's eclipse period is 3.0562868 days (1991, Rozcnik); the eclipse predictions below can be extrapolated to convenient times for your area).

A word of caution is necessary about the chart for Z Persei reproduced here. As noted on the chart, it is an AAVSO Preliminary Chart — the magnitudes indicated on it might not be absolutely accurate. However, for observing eclipsing binaries, we are more interested in the time of minimum light rather than the actual magnitude of minimum light so whether the magnitudes on the chart are absolutely correct or not doesn't affect us.

The upper right hand corner of the Z Persei chart indicates the total duration of the eclipse (Dp) is 9.5 hours with a standing minimum (dp) of 2 hours. This indicates that the brighter but smaller star is completely hidden behind the fainter but larger star for two hours. Observers attempting a Z Per eclipse for the first time should look at the accompanying composite light curve for Z Persei in order to know what to expect. Marvin Baldwin provided raw observations from five observers which were used, along with some artistic license, to derive this composite light curve. The horizontal axis of the light curve is annotated in 0.5 hour increments (0 marking mid-eclipse) while the vertical axis is in visual magnitude. The light curve shows the 2 hour standing minimum symmetric around mid-eclipse with about 90 minutes on both sides of the minimum when the star changes about 1.5 magnitudes in 90 minutes. The entire eclipse may take 9.5 hours, but all the critical action occurs in the five hours astride mid-eclipse.

To make it particularly easy to plan your observing session with Z Persei, the predicted times below correspond to the extreme left hand side of the lightcurve when the most dramatic drop in magnitude is about to begin. Note than mid-eclipse occurs about 2.5 hours after the times indicated. A telescope 6-inches aperture or larger should have no trouble handling this eclipse. Estimates of the variable's brightness should be made at about ten minute intervals and the observations recorded to the nearest minute.

Paul Sventek is a variable star observer with the AAVSO and a member of the Houston Astronomical Society.

Scanning the Literature

The Third Reference Catalogue of Bright Galaxies

by Brian A. Skiff

After many delays, the latest edition of the fundamental reference for observers of galaxies is out. The catalogue is available in either print form in three large volumes or on floppy disks.

This monumental work is the culmination of a career-long effort by Gerard de Vaucouleurs to provide basic information about the largest and brightest galaxies in the sky. Starting with the original Shapley-Ames list of 1,250 of the brightest galaxies, he attempted to determine or refine measures of position, dimensions, morphological type, magnitude, colors, and more on homogeneous systems. The first iteration, the *Reference Catalogue of Bright Galaxies* (now referred to as the *RC1*), published in 1964 by Gerard and Antoinette de Vaucouleurs, included nearly 2,600 galaxies. There were many blanks. This publication laid the foundation for outlining the observational work necessary to put basic "observables" like sizes and magnitudes on standardized systems.

By 1975, when the *RC2* was prepared, much work had been done to improve the database for bright galaxies, often by the de Vaucouleurses themselves and their colleagues. The *RC2* includes 4,360 galaxies, mostly larger than 1'.0, brighter than magnitude 15, and closer than 15,000 km/sec redshift. Analytical work in preparation for the catalogue lead to the standardization of isophotal dimensions, total magnitudes and colors, and redshifts on a consistent scale for both visible-light and radio measurements. Indeed, the systems thus established were widely adopted in the astronomical community.

The new catalogue is enlarged by a factor of five and the standard systems developed for the *RC2* have been put on an improved statistical footing. Whereas the earlier editions merely included galaxies larger, brighter, and/or closer than the limits noted above with information other than being listed in some catalog, the *RC3* attempts to be complete to this level. Completeness for objects in the southern hemisphere is vastly improved thanks to the surveys by Lauberts and Valentijn at the European Southern Obsevatory and by Harold Corwin, working with de Vaucoulers at the University of Texas. Some 22,500 photoelectric measurements allowed the derivation of total magnitudes and colors for 3,500 galaxies. Magnitudes based on photographic photometry have become available for thousands more objects. The many efforts to get redshift maps of the sky yielded velocities for 70 percent of the catalog entries. When results from infrared and radio surveys are added in, the results catalogued here represent many thousands of telescope-days and endless hours reducing and analyzing data.

Let's look at the contents of the catalog in a general way, and then I'll detail the entry for an individual object. The catalog contains 23,000 entries for galaxies brighter than total B magnitude 15.5, diameter at the B mag. 25 per square arcsecond isophote level of 1'.0 or larger, and with velocities of 15,000 km/sec or lower. Galaxies meeting all three criteria represent only half the catalog; the remainder are those fulfilling one or two of the criteria and other interesting objects. Precise positions (meaning in this case accurate to about 5 arcseconds or better) are given for 15,000 of the objects; the remainder have positions to only arcminute precision. Morphological types for 18,000 galaxies are given, mostly from Nilson's *UGC* in the north, and Corwin's *SGC* (*Southern Galaxy Catalogue*) in the south. About 1,000 types were contributed by me, about which more in a moment.

After many delays, the latest edition of the fundamental reference for observers of galaxies is out.

Dimensions at the mag. 25 isophote level, discussed in this space in the last several issues, are provided for 94 percent of the entries. Much effort was expended to tie the system of the *RC2* to new data: photographic and CCD surface photometry, and multi-aperture photoelectric measures. The system of dimensions was also adjusted so as to be consistent for both the southern and northern hemispheres, where the data sources are rather different. The mean uncertainties for the catalog dimensions are ± 12 percent. In other words, an object listed as being 2'.00 in the major dimension has a two-thirds chance of actually being between 1'.76 and 2'.24 long. These errors might seem to be rather large, but are about as good as can be done with the data at hand.

A new feature in the *RC3* compared to earlier editions is position angle, which is given for two-thirds of the entries. Most of these come from the *UGC* or the *ESO/Uppsala Survey of the ESO (B) Atlas*. No uncertainties are given for these, but my own experience with measuring position angles suggests ± 3 to 5 degrees is typical for objects that are neither very elongated (where it is easy to do better) nor nearly circular (where differences of 10 or 20 degrees are not unexpected).

I've spent a lot of space in this column discussing magnitudes for galaxies and how they're derived. The *RC3* gives total B magnitudes derived from photoelectric measurements for about 4,000 galaxies, a factor of four increase over the *RC2*. Their mean uncertainty is ± 0.16 magnitude. For 17,000 galaxies, total B is given based on photographic photometry, primarily from two sources. In the north, a large effort was made to correct the magnitudes given in the *Catalogue of Galaxies and Clusters of Galaxies* (*CGCG*) by Fritz Zwicky and colleagues to the standard system. I outlined the basic procedure in previous columns. For the region south of -20 degrees declination, a similar adjustment was made to the massive work by Lauberts and Valentijn. Because these latter measures were done digitally and tied to photoelectric or CCD aperture measures, the errors are much smaller, and only small adjustments were made, mostly due to the small shift in the standard dimensions between the *RC2* and *RC3*. The typical uncertainties for the photographic measures is ± 0.3 magnitude, although they can reach above half a magnitude for faint objects.

Total B-V colors are given for 3,500

galaxies, and so total V can be computed from total B for these galaxies, which include practically all the brighter galaxies in the sky.

Another important observational parameter, mean surface brightness, is given explicitly for 3,600 galaxies. The errors here are larger, ± 0.33 magnitude, reflecting a combination of effects. Inexplicably, the 13,000 or so galaxies with magnitudes derived only from photographic photometry lack a surface brightness entry; users will have to calculate them by hand as needed. I showed how this is done a few issues back. It is also discussed in the introduction to *Sky Catalogue 2000.0*, volume 2, by Hirshfeld and Sinnott.

Radial velocities are given both from spectra taken in visible light and from measurements of the 21cm hydrogen emission line at radio wavelengths. Results from the two sets of data (compiled from over 200 sources!) were adjusted to a common zero-point based on intercomparisons of large lists of velocities. For the very earliest source of galaxy redshifts, those of V. M. Slipher at Lowell Observatory around World War I, the zero-point correction for the 32 velocities included in the combined catalogue was found to be just +22 km/sec with a mean uncertainty of ± 49 km/sec. The mean uncertainty for all the visible-light entries, including measures made in the last few years, is 55 km/sec — Slipher was a careful observer!

There's lots more. But other entries in the *RC3* detail information outside the visible and parameters of little use for visual and photographic observation. Not to be overlooked, however, is the collection of bibliographic references, notes, appendices, and a huge cross-index of identifications, which together take up practically all of the 700-page volume 1 of the printed version. They don't call it a reference catalogue for nothing. For the convenience of users, the notes sections from both earlier editions are included — handy since the *RC2* has long been out of print, and about all that's useful still in the now very preliminary-looking *RC1* are the notes.

In 1986 I visually scanned a collection of plates taken with the UK Schmidt in Australia to measure sizes and determine morphological types of the galaxies that appeared on them. The variety of galaxian form is endlessly fascinating, and it was great fun making these classifications and comparing my types for brighter galaxies with the *RC2* and other sources. My catalog, trimmed of the many very faint objects to include just NGC/IC and UGC galaxies, was published in the Webb Society *Quarterly Journal*, number 77 for July 1989. I sent a file with nearly 2,000 types to Harold Corwin, who found they were good enough to include in the database for the *RC3*.

How good? Well, the introduction to the *RC3* gave me my first good look at how well I could classify galaxies. First, a catalog of accurate types based on large-scale telescopic photographs and other surveys was assembled and massaged to form a list of "standards." Using this as the basis for comparison, my catalogue and other lists were analyzed for systematic differences and statistical errors. (Most of this work was done by Ron Buta, now at the University of Alabama.) Galaxy stages are coded along a scale from T = -6 to +11, where a compact elliptical is -6 and a compact irregular is +11. The difference between, say, an Sbc and Sc galaxy is one unit (+4 and +5); the transition stage between lenticulars and spirals (S0/a) is zero.

On average my types had no significant shift from the standard scale: what the standard list calls an Sbc I also called an Sbc. The typical entry in my list has an error (standard deviation) of about +/- 0.9 on the T scale. Thus a galaxy I classed as Sbc is likely to actually be somewhere between Sb and Sc more than two-thirds of the time. The classifications in Harold Corwin's *Southern Galaxy Catalogue*, with types for over 5,000 galaxies, are about the same quality, and indeed were also done on UK Schmidt plates. Using the photos in the *Hubble Atlas of Galaxies* and the *Revised Shapley-Ames Catalogue* as a guide, it appears one can do classifications of as good quality as the experts.

The very first entry in the *RC3*, UGC 12889, is perhaps as typical as any. The information is presented on four lines. The first column has positional information: RA and Dec. are given for both equinox 2000.0 and 1950.0. Note that the position of the galaxy is known to a few arcseconds. The intervening numbers are the galactic and supergalactic latitude and longitude. UGC 12889 lies only 14.7 degrees from the galactic plane in Andromeda. The next column shows identifications, the bottom line always being the number from the *Principal Galaxy Catalogue*, the massive database discussed here in the Winter 1989 issue (#29).

Column 3 lists the type, its source(s), and an uncertainty, which is based on the mean errors of the source, as discussed above, factored in with the size of the galaxy — smaller objects will have larger uncertainties. This galaxy is classed as SB(rs)b (decoded from the symbols in the top line), classed by Nilson in the *UGC*, and the uncertainty is ± 0.7 in T (a fairly small error).

Next come dimensions and their errors, of which the first two lines are of interest for visual observing. $LogD_{(25)}$ is the long dimension at the B magnitude 25 isophote; for UGC 12889 it is 2'.1 ± 0'.1 in linear units. $LogR_{(25)}$ is the ratio of the long and short axes; the short dimension can be found by simply subtracting logR from logD, yielding 1'.8 in linear units with a similar error. In the first line of the fifth column, we see that the galaxy is elongated in position angle 165 degrees.

The first two lines of column 6 give total B magnitudes based, respectively, on photoelectric and photographic measures. Here only the photographic magnitude is supplied, 13.4 ± 0.3. Since this is in the northern hemisphere, the source is the Zwicky catalogue, corrected for many systematic effects. The next column, giving B-V and U-B colors is blank, since there are no photoelectric measurements. The galaxy's surface brightness, omitted here (m'_{25} in column 8), I calculate to be magnitude 14.7 per square arcminute, fairly typical for a mid-stage spiral. Remember, the total V magnitude and surface brightness will be about 0.8 mag. brighter than these values.

The first line in the rightmost column gives a radial velocity based on a 21cm radio determination: 5017 km/sec ± 9 km/sec. The galaxy is some four or five times farther away than objects near the center of the Virgo cluster.

How to Get the *RC3*

The three-volume printed version of the catalogue can be ordered from Springer-Verlag. Their toll-free number is 800-777-4643. The ISBN number for the set is 97552-7 (last six digits); the price is $198. Volume 1, which contains the introduction, references, notes and appendices, can be obtained separately for $69 (ISBN 97549-7).

Regarding machine-readable copies, Harold Corwin writes: "A corrected version of the *RC3* is and will always be available directly from me on IBM PC-formatted disks — preferably 1.44 MB 3.5-inch diskettes: the whole thing, with unpacking software, fits onto two of them. However, I can also do 1.2MB 5.25-inchers (three of them), 360KB 5.25s (eight of them), and 720KB 3.5s (four of them) When you tell people this, please have them send their own floppies with return postage, or preferably, with a pre-stamped pre-addressed mailer." Use a mailer that will hold five or six disks, since printed documentation will be included in the package. Harold suggests buying the print version of volume 1 and getting the catalog files from him on floppies. The address is: IPAC, MS 100-22, Caltech, Pasadena, CA 91125.

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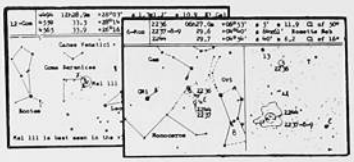

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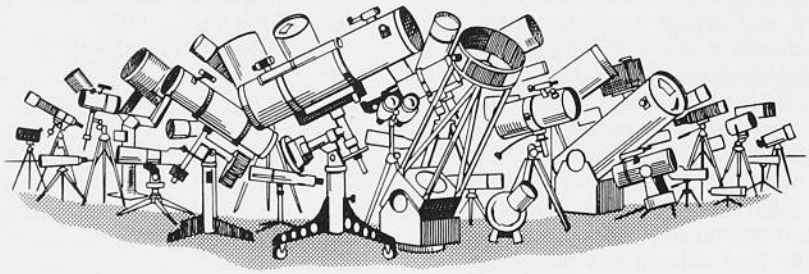

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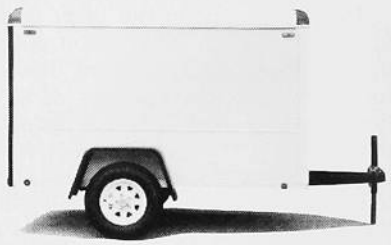

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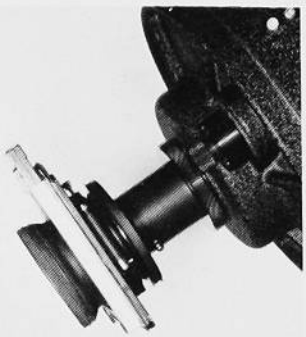

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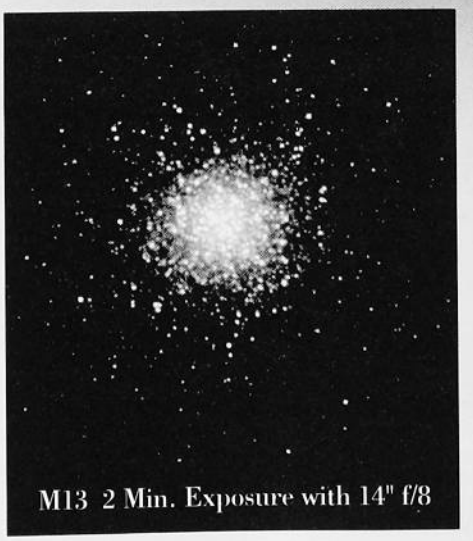

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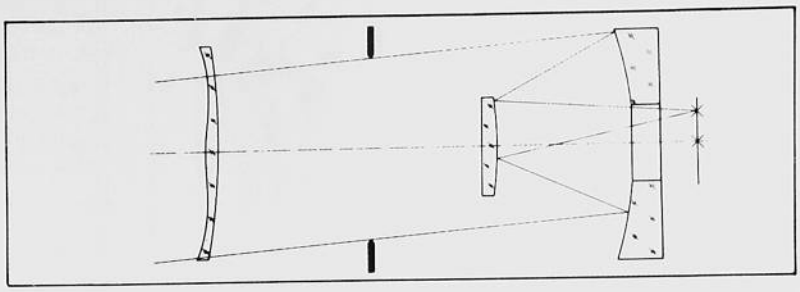

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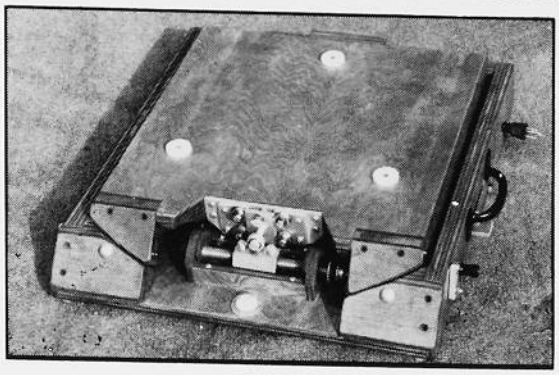

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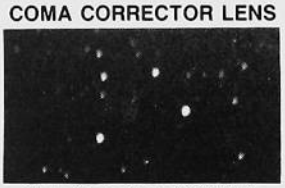
LUMICON 50mm, 80mm SUPER-FINDER™

Visual Astronomers perfer the LUMICON 80mm SUPER-FINDER™, since hundreds of deep-sky objects, including most Messier objects, are visible directly. SUPER-FINDERS also make nice small portable telescopes. 80mm aperture, F = 300mm coated achromat. The deluxe SUPER-FINDER uses an 80mm, F = 500mm air spaced achromat.

1¼" 50mm Finderscope	**$59.50**, right-angle **$89.50**
1¼" straight-thru 80mm SUPER-FINDER	**$169**
1¼" right-angle version, w/star diagonal	**$195**
1¼" Deluxe right-angle Super-Finder	**$279**
25mm Cross-hair 1¼" eyepiece (12X)	**$29**
1¼" Star Diag. **$32**, 2" Star Diag., silver,	**$159**
1¼" Amici Prism diag. for correct left-right views	**$69.50**

COMA CORRECTOR LENS



Coma 1 inch off-axis (17½" f/4.5)

Same Field with LUMICON coma corrector lens; note smaller, more numerous stars.

This computer-designed LUMICON 2" lens reduces coma and flattens the field for both viewing and photography. It threads into LUMICON 2" EASY-GUIDERS for effortless installation. This lens is optimized for f/4.5 and reduces aberrations for f/3.5 to f/5 Newtonians. Off-axis images are much smaller, making off-axis guiding far easier and yielding round pinpoint star images in photos. Since star images are sharp over a full 2¼" circle, you can use medium format cameras in addition to 35mm cameras. This zero power lens does not change image scale nor shift focus, and all lens surfaces are multi-coated for highest efficiency. Although designed for photography you may also use this lens to improve image quality in wide-field viewing with low power eyepieces.

LUMICON Coma Corrector/Field Flattener
2" lens **$285.00**
Extension tube for viewing **$26**
2" Easy-Guider™ (state camera) .. **$169.50**

NEW! ENCHANCED SILVER DIAGONAL MIRRORS BOOST TELESCOPE PERFORMANCE

LUMICON 1.3" & 3.1" enhanced silver diagonal mirrors & 2" star diagonal.
The new LUMICON diagonal mirrors have a special enhanced silver coating with a protective overcoating for long life. Visible reflectivity is 98-99% compared to 86-89% for standard aluminum coated mirrors. The extra 10-12% transmission is like adding an inch of aperture! The substrate is fine annealed Pyrex flat to 1/8 wave.

1.32"	**$29.95**	1.52"	**$34.50**	1.83"	**$39.50**
2.14"	**$49.50**	2.60"	**$65.00**	3.10"	**$89.50**

ENHANCED SILVER STAR DIAGONAL

90° star diagonals with above enhanced silver mirrors in a CNC machined black anodized aluminum body. Performance far exceeds prism diagonals.
1¼" (1.32" mirror) **$99.50**
2" (1.83" mirror)(see photo above) .. **$159.00**

OXYGEN-III FILTER

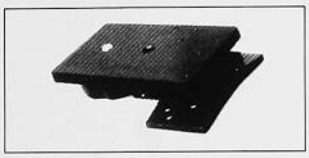
Helix Nebula, NGC 7293 in Aquarius. Bright and easy with Lumicon Oxygen-III Filter.

The ultimate in filter performance! The Lumicon Oxygen-III Filter has a contrast twice as high as the high performance Lumicon UHC Filter™. Use the Oxygen-III Filter for observing the very faintest planetary and diffuse emission nebulae. Also gives incredible views of bright nebulae (like M-27, M-17, etc.) from urban locations. Bandpass is 11nm, transmission is 90% for both O-III lines at 496nm and 501nm.

Filter Type	**1¼"**	**48mm**
Lumicon Oxygen-III	**$99.50**	**$199.50**
Lumicon UHC	**$99.50**	**$199.50**
Lumicon Deep-Sky	**$79.50**	**$119.50**
Set UHC and Oxygen-III	**$190.00**	**$380.00**

NOTE: The Oxygen-III Filter is not a substitute, but a compliment to the UHC Filter. **1 year guarantee:** You must see nebulae with the O-III filter that are **invisible** without a filter.

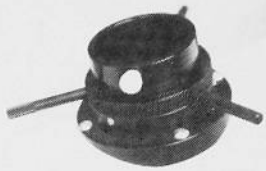
NEW ADJUSTABLE PIGGYBACK MOUNT



LUMICON has just designed a new adjustable piggyback mount ideal for all telescopes of 8-14" aperture. It has **both** vertical and sideways adjustment to allow optical alignment. It was designed to allow mounting of the LUMICON SUPER-FINDER on C-8, C-14, etc., but is ideal for any telephoto lenses or small telescopes.

Deluxe Piggyback Mount **$54.00**
(State Telescope Type)
LUMICON 12x80mm SUPER-FINDER $195.00

NEW! LOW PROFILE HELICAL FOCUSERS



LUMICON® DELUXE NON-ROTATING HELICAL FOCUSER on a 6" telescope.
LUMICON now offers 3 different low-profile helical focusers. They stand only 1¼-1½" above the telescope tube. Use the 1¼" or 2" versions for viewing. Use the 2" non-rotating focuser for convenient photography with the LUMICON 2" EASY-GUIDER™.
Select your desired base-plate shape!
Flat, 7" OD, 9½" OD, 12½" OD, 16" OD, 21" OD, SUPER-FINDER base plate.
LUMICON 1¼" Helical Focuser **$49.50**
LUMICON 2" Helical Focuser **$59.50**
LUMICON Non-rotating Helical Focuser **$89.50**
3 handles (see photo) for non-rotat. focuser **$12.95**
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2" LUMICON EASY-GUIDER **$169.50**

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Protect your valuable telescope optics, eyepieces and accessories with these black vinyl covers. Add $1 shipping. Deduct 10%, 2 or more sets.

1¼" O.D. plug, seals focuser	**4/$2**		
2" O.D. plug	**2/$2**	3½" O.D. plug	**$1.50**
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FILM HYPERSENSITIZATION KITS†

LUMICON HYPER-KITS™ yield 3-15X film speed gain in long exposures. They are safe & simple to use. Easy HYPER-KIT includes a chamber with all controls and fittings, thermometer, a refillable cylinder of non-flammable forming gas & hand-operated vacuum pump.

†U.S. Patent 4,473,636

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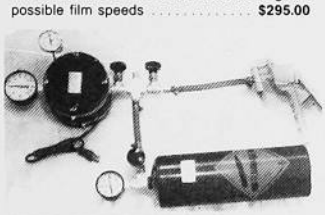

MODEL 600 HYPER-KIT (See Photo) Like the Model 300, but also sensitizes 120/220 larger format film and small glass plates **$350.00**

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Temperature controller for any HYPER-KIT **$65.00**

Electric Vacuum Pump **$319.00**

GUIDE OFF-AXIS FOR LOVELY ASTROPHOTOS

All **LUMICON EASY-GUIDER™** off-axis guiders† have both radial and 360° rotational adjustments for 5X easier guide-star selection, use 48mm filters, 360° camera rotation, large prisms of bright guide-starts. *Specify Camera and Telescope type.*
U.S. Patent #4,448,500

NEWTONIAN EASY-GUIDER™

Full aperture. Installs in secs. Specify 2" or 1¼".

NEWTONIAN EASY-GUIDER **$169.50**
3X Relay Diagonal (see photo) **$89.50**
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Guider for Hasselblad **$350,** Mamiya 645 **$199**

CASSEGRAIN EASY-GUIDER™

For C-8, Meade 2080, Dynamax-8. Includes 50mm achromatic lens for f/5.8 operation —3X shorter exposures! **Superb rich field viewing, too!**

CASSEGRAIN EASY-GUIDER **$225.00**
Adapter for Hasselblad $185, Mamiya 645 **$98**

GIANT EASY-GUIDER™

For Celestron-11, C-14, and the 10" Meade 2120. Includes 80mm clear aperture achromatic lens for edge-to-edge illumination & pin-point star images. F-ratio adjustable f/4-f/11. **Also yields unmatched Rich-Field viewing.**

GIANT EASY-GUIDER **$395.00**
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Adapter for Hasselblad adapter **$195,** Mamiya 645, **$119**

WHAT DO YOU NEED?

1. Illuminated reticle eyepiece **$99.50**
Lumicon 12mm eyepiece system has adjustable L.E.D. illumination, dual crosslines, battery pack.

2. Cable release for long exposures .. **$9.95**

3. **LUMICON Quartz Drive Corrector . $219**
Dual-axis drive corrector is essential for astrophotography and/or field use of your telescope. 40Hz/80Hz variable output controls telescope drive. 60Hz Quartz reference ±12VDC Declination control output. Both 110VAC and 12VDC input for home or field use. Declination reverse switch for Newtonians.
Declination motor (state telescope) .. **$99**
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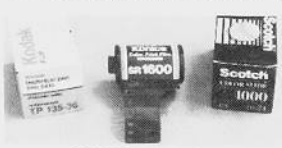

HYPERSENSITIZED FILM
LUMICON Hypersensitized film is essential for good deep-sky astrophotography. Deduct 10% for 3 or more rolls (mixed o.k.).

Film Type, 35mm	**Exposures**	**Price**
2415, Ultra-fine B&W, red sens.	36	**$10.95**
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Konica SR400, fine gr. color neg	12	**$10.95**
3M 1000, fastest slide film	20	**$12.95**
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5072, color slides from negs	36	**$6.95**
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Paracorr™ Eats Coma

At Last, a *Universal* Coma Corrector for Parabolic Mirrors

There's no question large aperture reflectors like John Vogt's excellent 30" f/3.8 produce deep sky views rivaling those I've seen in major observatories. But his scope, like yours, is limited in field sharpness. The main offender is coma, an aberration which makes stars look like blurry comets. Visually and photographically, the faster the scope the worse the effect.

If we compensate for coma before starlight reaches the eyepiece, then the best eyepieces will be used to fullest advantage, and a sharp full frame 35mm photograph is possible. In sum, my design goals were:

1. maximum reduction in coma and field curvature without compromising spherical aberration and color correction

2. major sharpness improvement for all popular focal ratios

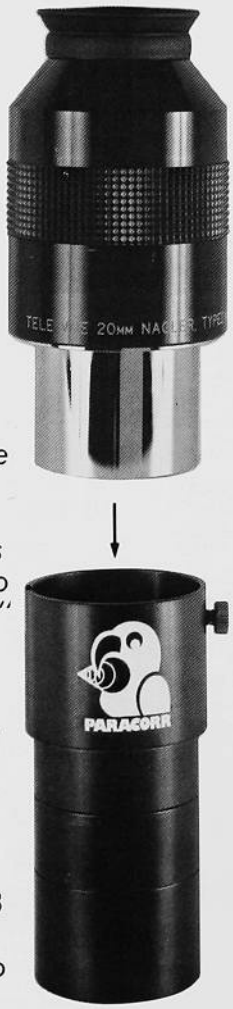
3. equally effective visually or for 35mm film

4. as convenient to use as a Barlow lens

I hope you agree that Paracorr, the coma eater, is the missing link necessary to fully enjoy your "DobNewt."

—Al Nagler

PARACORR™



The Formula For Increasing Sharp Field

A perfectly made 13" f/4.5 parabola has only about .1° diffraction-limited field. Now add Paracorr plus a Nagler eyepiece to your f/3.5 – f/8 parabola and tremendously increase your sharp field. Extract all the performance the atmosphere and your mirror quality will allow. Since Paracorr tightens and intensifies star images, enjoy resolving globular clusters as they drift right to the edge of your field of view. No more finding the "sweet spot" of focus. The entire field is your "sweet spot"!

Astrophotography

Rival a Schmidt Camera? Mount your 35mm SLR to Paracorr, and the quality of full frame photos will be spectacular since star image sizes are designed to be less than .001 inch over the field for an f/4.5 mirror.

Easy To Use

Paracorr drops in like a Barlow lens. With only a slight 1.15x magnifying factor, an f/4.5 telescope becomes an f/5.17. While optimized for Tele Vue eyepieces, other makes can be used. Of course the better the eyepiece, the better the results. The 1¼" Paracorr is parfocal with most Tele Vue eyepieces. The 2" Paracorr requires about ½" in-travel from your current focus location. Can't be simpler for any scope, any eyepiece, and any 35mm SLR camera.

Paracorr — The Missing Link

An optical chain is as good as its weakest link. With the development of 82° Nagler eyepieces, Tele Vue offers the largest, flattest and best corrected visual fields in the industry. Combine the Nagler revolution, Dobsonian revolution and Paracorr for the ideal mating for flat-field and sharpness, visually and photographically. Try Paracorr on your "DobNewt." We think you'll agree that the revolution is complete.

A) parfocal 2"-1¼" adapter
B) 2" eyepiece holder
C) lens assembly threaded for T-rings

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